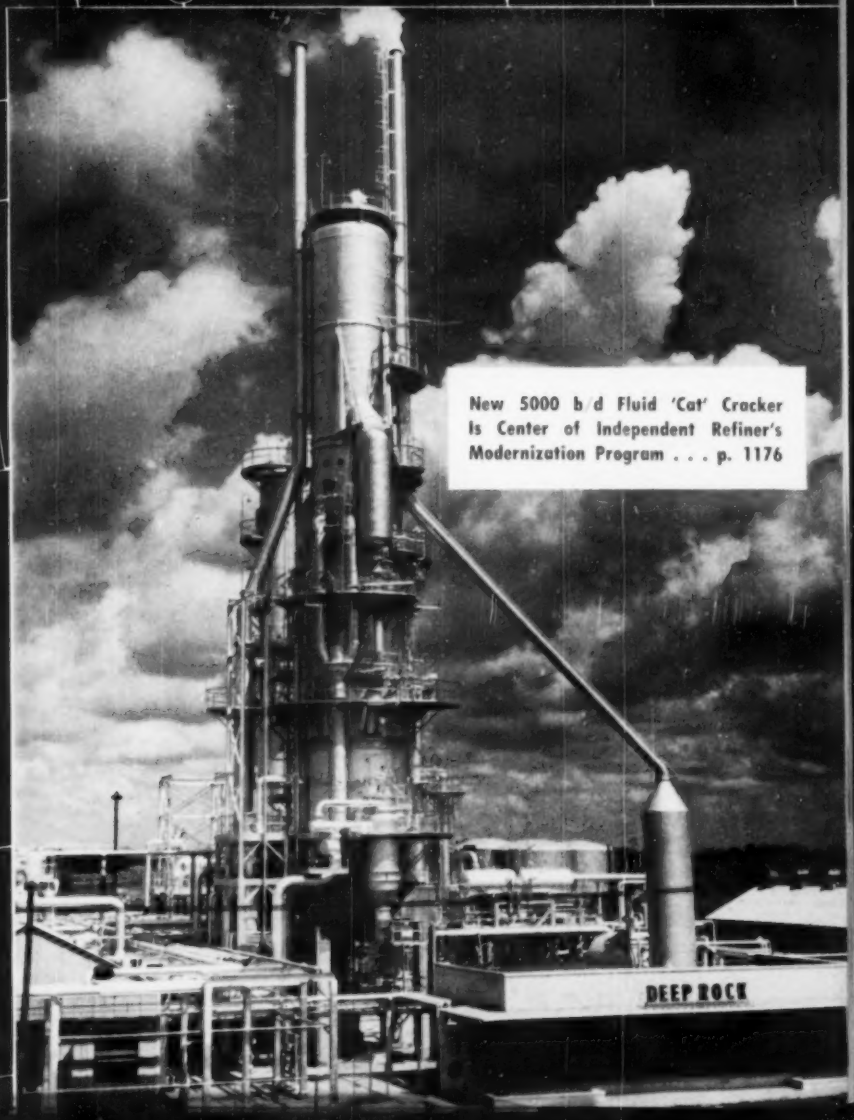
NOVEMBER, 1950
VOL. 5, NO. 11

PETROLEUM PROCESSING



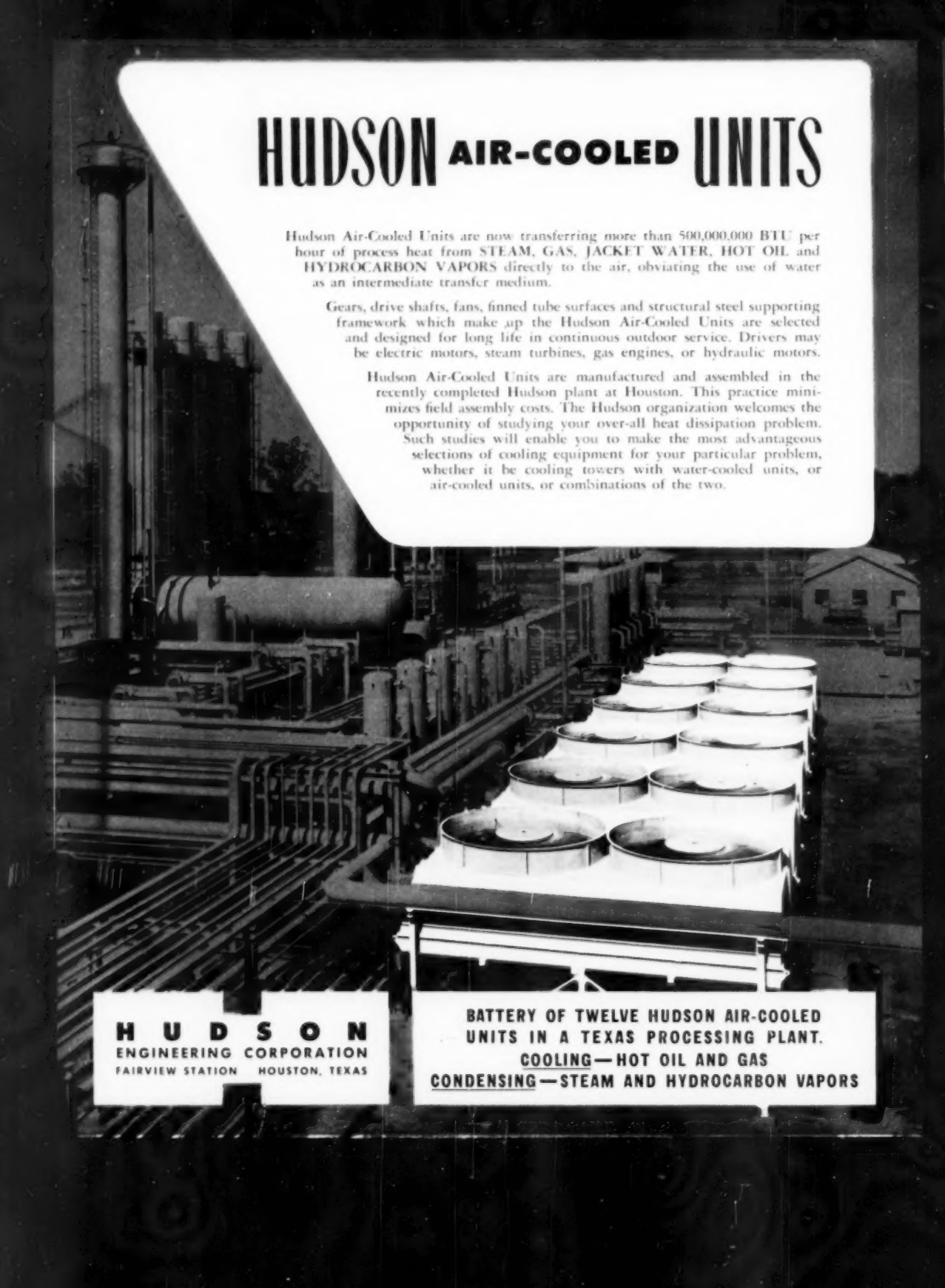
New 5000 b/d Fluid 'Cat' Cracker Is Center of Independent Refiner's Modernization Program . . . p. 1176

HUDSON AIR-COOLED UNITS

Hudson Air-Cooled Units are now transferring more than 500,000,000 BTU per hour of process heat from STEAM, GAS, JACKET WATER, HOT OIL and HYDROCARBON VAPORS directly to the air, obviating the use of water as an intermediate transfer medium.

Gears, drive shafts, fans, finned tube surfaces and structural steel supporting framework which make up the Hudson Air-Cooled Units are selected and designed for long life in continuous outdoor service. Drivers may be electric motors, steam turbines, gas engines, or hydraulic motors.

Hudson Air-Cooled Units are manufactured and assembled in the recently completed Hudson plant at Houston. This practice minimizes field assembly costs. The Hudson organization welcomes the opportunity of studying your over-all heat dissipation problem. Such studies will enable you to make the most advantageous selections of cooling equipment for your particular problem, whether it be cooling towers with water-cooled units, or air-cooled units, or combinations of the two.



HUDSON
ENGINEERING CORPORATION
FAIRVIEW STATION HOUSTON, TEXAS

BATTERY OF TWELVE HUDSON AIR-COOLED UNITS IN A TEXAS PROCESSING PLANT.
COOLING—HOT OIL AND GAS
CONDENSING—STEAM AND HYDROCARBON VAPORS

Effectiveness of "Lead" in Suppressing Autoignition Assumes New Importance to Refiners

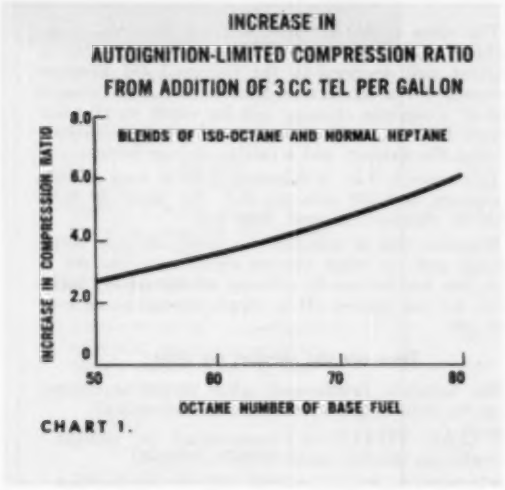


CHART 1.

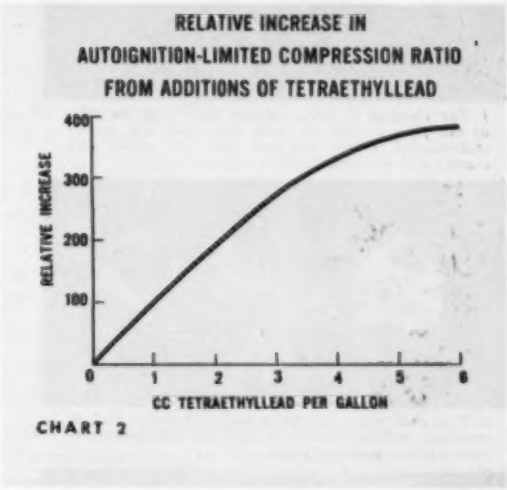


CHART 2

Tetraethyllead's effectiveness for reducing the tendency of fuels to autoignite was demonstrated by Ethyl as early as 1935. Since that time, this original knowledge has been expanded by a continuing research program.

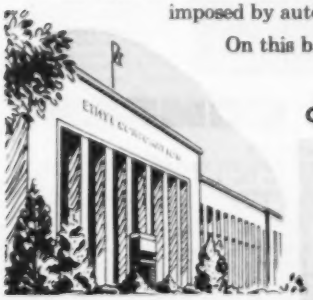
The most significant fact disclosed by Ethyl's research is that the effectiveness of tetraethyllead in controlling autoignition increases both as the antiknock quality of the base gasoline is improved and as the concentration of lead is increased.

An engine was driven at 900 rpm with greatly retarded ignition. The compression ratio was slowly increased until firing was initiated by autoignition of the fuel. The compression ratio was then reduced slightly until firing ceased. This value was considered to be the limiting compression ratio imposed by autoignition.

On this basis, when the base fuel was a 50-50 blend of iso-octane with normal heptane, the addition of 3 cc of tetraethyllead per gallon of fuel enabled the engine to operate without autoignition at 2.6 ratios higher compression. When the base fuel was an 80-20 blend of iso-octane with normal heptane, 3 cc of tetraethyllead permitted an increase of 6.1 ratios (Chart 1).

The high effectiveness of the second and third cc of tetraethyllead in the suppression of autoignition is shown in Chart 2. Two cc are almost twice as effective as one cc; three cc are 2.7 times as effective as one. Additions of tetraethyllead beyond 3 cc per gallon also have a high effectiveness.

The data show that tetraethyllead offers the refiner—and the eventual user of his gasoline—a double value. It is effective in suppressing autoignition as well as knock. Both of these contributions will increase in importance in the future.



Over 400 specialists working full time on fuel and engine developments

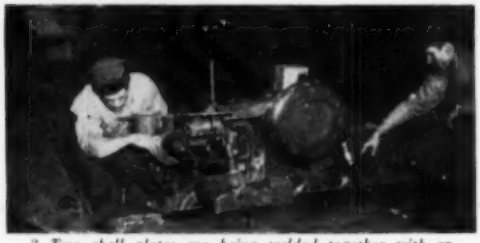
ETHYL CORPORATION
RESEARCH LABORATORIES

DETROIT, MICHIGAN
1600 West Eight Mile Road

SAN BERNARDINO, CALIFORNIA
2600 Cajon Road

ETHYL

1. The cladding is being chipped back from the edge of the plate so that the mild steel weld will not be contaminated. Before this was done, the plates were marked and trimmed.



2. Two shell plates are being welded together with an automatic welding machine in this view. This process insures uniform quality of welds.

3. Here the plates forming one ring of the shell are being tack welded manually. The completed welds are made on automatic machines.

Building a Stainless Clad Steel FRACTIONATING COLUMN

The views at the left show some of the steps in the building of the main fractionating column for a catalytic cracking unit designed by the Universal Oil Products Company for a refinery in Michigan. It is an integral part of a catalytic cracking unit for which we also furnished the reactor—regenerator column, the stripper column, the stripper, and a catalyst storage hopper.

This tower is 9 ft. in diameter by 69 ft. long and has a capacity of 9,000 bbls per day. The lower 30 ft. is built of chrome clad steel, type 405.

Whatever type of structure you need—refinery tower, storage tank, or other process equipment—you act in your own best interest by selecting an experienced fabricator. Let our nearest office supply quotations on your next job.

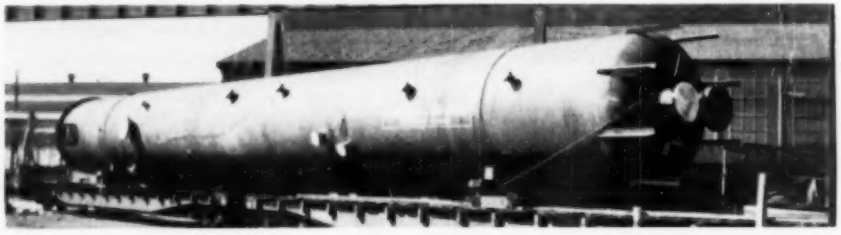
Here are the services we offer:

We fabricate towers and other process equipment from the following corrosion-resistant materials:

- CLAD STEELS — Chrome-nickel or straight chrome stainless steel, Monel or nickel.
- LININGS—Chrome-Nickel, straight chrome and ELC stainless steel, Monel, nickel, or Everdur.
- SOLID METALS — Chrome - nickel, straight chrome and ELC stainless steel, Monel, aluminum, nickel or Everdur.

Our stress-relieving facilities can handle vessels of the following dimensions in one heat: Chicago—13 ft. 6 in. in diam. by 83 ft. long, Birmingham—13 ft. in diam. by 79 ft. long, Greenville—13 ft. 6 in. in diam. by 63 ft. long. Longer vessels may be stress relieved by two or more heats.

Our shops have the necessary facilities and experience for fabricating process equipment to meet API or ASME codes or exacting customer specifications.



4. This view shows the tower ready to leave our plant in Birmingham for a refinery in Michigan. It is 69 ft. long and the lower 30 ft. is built of chrome clad steel type 405.

CHICAGO BRIDGE & IRON COMPANY

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

Atlanta 3 ..... 2103 Healey Building
Birmingham 1 ..... 1327 North Fiftieth Street
Boston 10 ..... 1029–201 Devonshire Street
Chicago 4 ..... 2114 McCormick Building
Cleveland 15 ..... 2215 Guildhall Building
Detroit 26 ..... 1532 Lafayette Building
Houston 2 ..... 2130 National Standard Building
Havana ..... 402 Abreu Building
Los Angeles 17 ..... 1526 General Petroleum Building
New York 6 ..... 3310–165 Broadway Building
Philadelphia 3 ..... 1630–1700 Walnut St. Building
Salt Lake City 4 ..... 330 West 17th South Street
San Francisco 4 ..... 1539–200 Bush Street
Seattle 1 ..... 1330 Henry Building
Tulsa 3 ..... 1620 Hunt Building

REPRESENTATIVES AND LICENSEES

Horton Steel Works, Limited, Fort Erie, Ontario, Canada
Ateliers et Chantiers de la Seine Maritime, Paris, France
Constructions Metalliques de Provence, Arles-sur-Rhone, France
Chicago Bridge & Iron Company, Ltd., Apartado 1348 Caracas, Venezuela
Sociedade Chibridge de Construcoes Ltda., Rio de Janeiro, Brazil
Compagnia Tecnica Industrie Petroli, Rome, Italy
Whessoe Limited, Darlington, England
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland
Comprimo N. V., Amsterdam-O, Netherlands

PETROLEUM PROCESSING

Covering petroleum research and the design, management, operation and maintenance of plants processing hydrocarbon materials into fuels, lubricants and chemicals

1213 West Third St., Cleveland 13, Ohio

A Platt Petroleum Publication

CCA

WARREN C. PLATT, *President*
ALBERT W. BOULTON, *Vice President*
A. E. KRAFT, *Treasurer*

EDITORIAL STAFF

VIRGIL B. GUTHRIE, *Editor*
WILLIAM F. BLAND, *Engineering Editor*
WILLIAM C. UHL, *Equipment Editor*
PETER J. GAYLOR, *Patent Reviewer*
D. P. THORNTON, Jr., *Southwestern Editor, 320 First National Bank Bldg., Houston 2, Texas*

Editorial Affiliates

PAUL WOLLSTADT, *News Editor*
H. A. YOCOM, *Washington Bureau Chief*

ADVERTISING SALES STAFF

K. W. McKINLEY, *Manager*

Regional Representatives

NEW YORK 20, NEW YORK
P. S. Carberry, 50 West 50th Street

PHILADELPHIA 3, PA.
C. J. Jefferis, 135 South 17th Street

CLEVELAND 13, OHIO
Jack Walton, 1213 West 3rd Street

CHICAGO 5, ILL.
R. D. Henriquez, 59 East Van Buren Street

HOUSTON 2, TEXAS
George Reid, 320 First National Bank Bldg.

SAN FRANCISCO 4, CALIF.
Robt. W. Walker Co., 68 Post Street

LOS ANGELES 5, CALIF.
R. W. Walker, 684 S. Lafayette Park Place

Published second Tuesday of each month by National Petroleum Publishing Co., 1213 West Third St., Cleveland 13, Ohio. Subscriptions: $8.00 a year in U.S. and possessions, $8.50 a year elsewhere. Single copies, 75 cents each; back copies more than three months old, $1.00 each. Published prior to Sept., 1946, as the *Technical Section of National Petroleum News*, devoted to Refinery Management and Petroleum Chemical Technology, and including *International Petroleum Technology*. Trade mark registered U.S. Patent Office. Copyright 1950 by National Petroleum Publishing Co. Acceptance under the act of June 5, 1934, at Cleveland, Ohio, authorized Dec. 22, 1948.

VOL. 5, NO. 11 NOVEMBER, 1950

Contents

FEATURE ARTICLES

Organize Plant Protection NOW, *by Frank V. Martinek* 1173

New Crude Topper, Cracker Expand Independent Refiner's Facilities, *by D. P. Thornton, Jr.* 1176

The Availability of LPG for Direct Motor Fuel Use, *by R. C. Alden* 1180

Reforming, LGP Recovery Units Installed in Trieste Refinery 1187

Want a Temperature Record—Dial It!, *by E. J. Grace, Jr.* 1188

How to Control Welding Quality, *from a report by A. F. Blumer* 1192

More Refiners Describe Their Waste Disposal Program 1196

Economics of Petroleum Coking for "Cat Cracking" Feed Preparation, *by J. W. Jewell, Jr. and J. P. Connor* 1199

Thermodynamic Properties of Propane, *by Ju Chin Chu, Norman F. Mueller, R. M. Busche and A. S. Jennings* 1202

DEPARTMENTS

What's Happening! 1139

Tomorrow in Petroleum Technology, *by B. H. Weil* 1145

Letters 1151

Plant Practices, Practical Tips and Ideas 1205

Processing Patents, *by Peter J. Gaylor* 1211

Equipment Patents 1217

News of Suppliers 1221

Meetings for the Oil Man 1227

Book Reviews 1230

Refining Trends—Current Statistics 1233

Advertisers' Index 1236

What's New! Equipment, Material, Processes, Literature 1237

Personals 1248

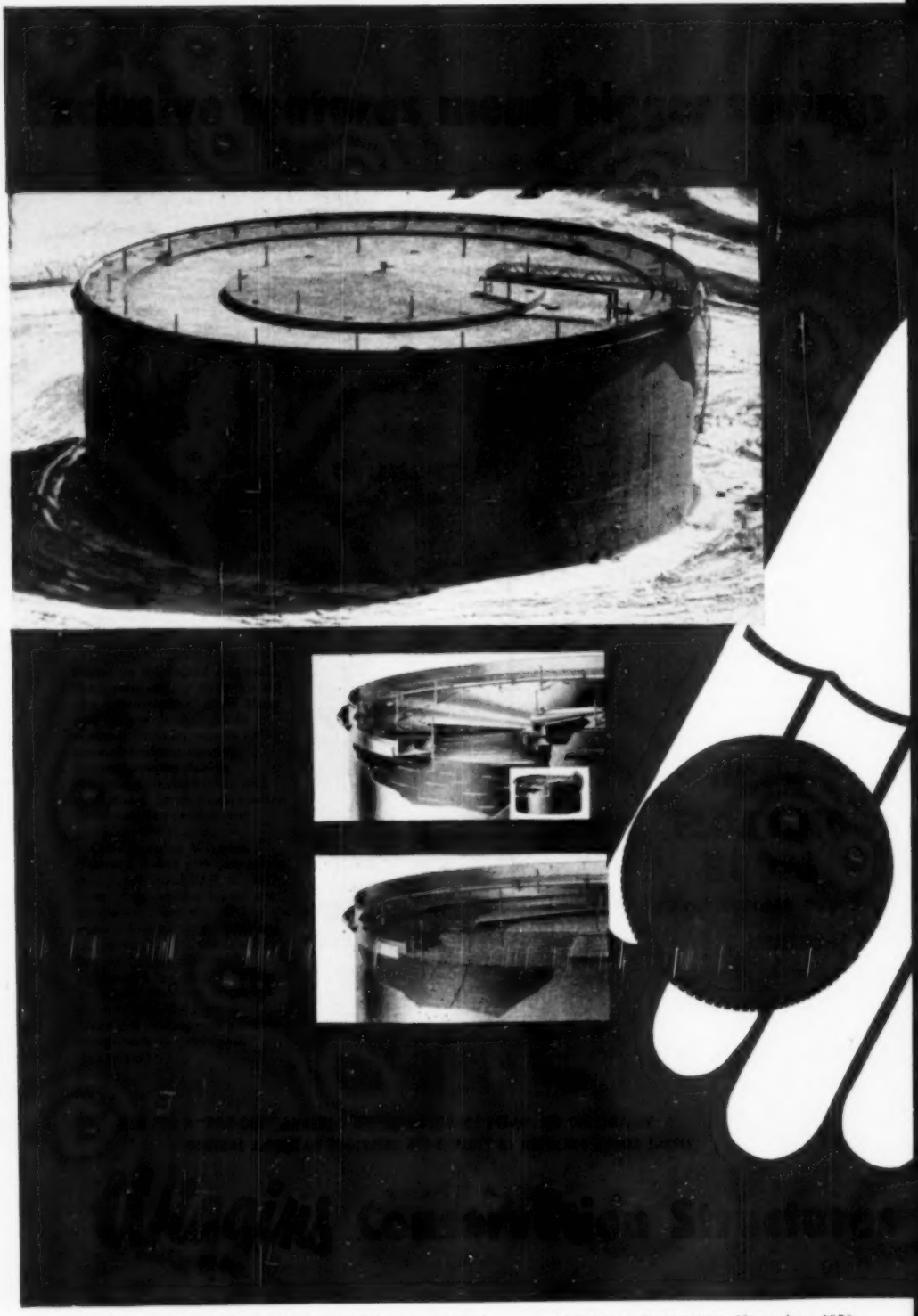
Editorial Viewpoints 1252

Other Platt Petroleum Publications

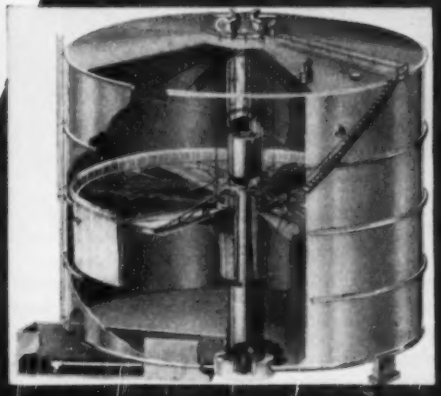
PLATT'S OILGRAM NEWS
A daily independent oil-news reporting service issued from New York, Cleveland, Houston

NATIONAL PETROLEUM NEWS
The weekly oil marketing magazine, covering news, prices, transportation, storage, merchandising

PLATT'S OILGRAM PRICES
A daily independent oil-price reporting service issued from New York, Cleveland, Houston

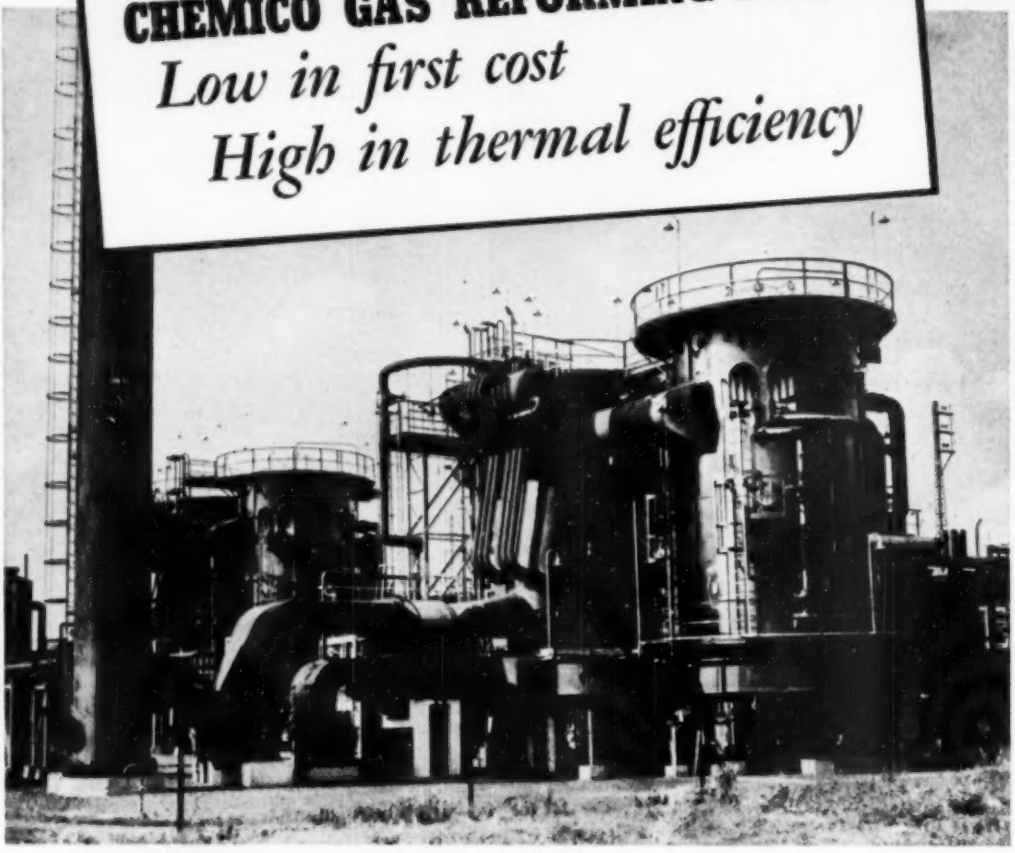


more rapid pay-out!



CHEMICO GAS REFORMING PLANT

Low in first cost
High in thermal efficiency



Among the many types of heavy chemical plants Chemico designs and constructs are those for the production of synthesis gas, principally hydrogen. The gas reforming plant, shown above, is located in the synthetic ammonia works of the Office National Industriel de l'Azote at Toulouse, France. It has been operating successfully for a year and a half.

Other Chemico installations for the catalytic reforming of natural gas have been producing for as long as eight years. The total output of all these plants is more than 180,000,000 cu. ft. of reformed gas per day. Four more plants are now under construction in the United States and foreign countries.

Chemico's design provides important advantages. These plants are low in first cost, high in thermal efficiency. Construction is simple. The plant is foolproof . . . requires a minimum of operating and maintenance attention.

CHEMICO
GAS REFORMING PLANTS
are used for making:

- **Hydrogen-nitrogen mixtures for ammonia synthesis.**
- **Hydrogen and carbon monoxide mixtures for methanol synthesis.**
- **Carrier gas for blending with natural gas for distribution by Public Utilities.**
- **Hydrogen for industrial uses.**

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

488 MADISON AVENUE, NEW YORK 22, N. Y.

EUROPEAN TECHNICAL REPRESENTATIVE: CYANAMID PRODUCTS, LTD., LONDON W. C. 2, ENGLAND
EUROPEAN LICENSEE OF N. E. C. PROCESS: HYDRO-NITRO S. A., 6 QUAI DU CHEVAL BLANC, GENEVA, SWITZERLAND
CABLES: CHEMICONST, NEW YORK

CC 810

Chemico plants are profitable investments

WHAT'S HAPPENING

Current News Summarized For Oil Men

EXPANSION

Nearly half a billion dollars is being spent this year by the petroleum industry for the development, modernization and expansion of petroleum processing facilities in this country. On the basis of a survey recently conducted by the American Petroleum Institute, $394 million is being laid on the line for new and improved refining facilities, and an additional $74 million for natural gasoline plants—making a total of $468,000,000.

These figures compare to actual average capital expenditures during the past four years (1946-49) of $457 million for refining and $66 million for natural gasoline—a total of $523,000,000 per year.

Imperial Oil Co. plans to start construction late this year on an 11,000 b/d Fluid catalytic cracking unit and a vacuum pipe still at its 20,000 b/d Edmonton, Alberta, refinery. Plant capacity will not be increased. Cost will be about $5,000,000, and completion is scheduled for next fall. Contracts were not yet let as of Nov. 2.

Kerr-McGee Oil Industries at Wynnewood, Okla., is spending $600,000 on remodeling, conversion and additions to its 6,000 b/d refinery to increase plant capacity to 10,000 b/d. Program is scheduled for completion next month.

Standard Oil Co. (Ohio) has begun construction of a new $350,000 waste water separator at its Lima, Ohio, refinery. Arthur G. McKee & Co., Cleveland, is contractor.

Lake Superior Refining Co. has purchased Carter Oil Co.'s 4,000 b/d refinery at Cut Bank, Mont., for re-erection at Superior, Wis., by Feb. 15, 1951. Plant will use Alberta, Canada, crude, with a 2-year option on sufficient crude to support plant capacity increase to 10,000 b/d through addition of catalytic cracking and another crude topper. Refinery Engineering Co., Tulsa, is handling both dismantling and re-erection of the plant; work has started at both points.

Onyx Refining Co., Abilene, Tex., has approved a $650,000 expansion plan to boost present 4,250 b/d crude throughput to 5,500 b/d by June 1, 1951. Principal additions will be a Platforming unit under license from Universal Oil Products Co., and new thermal cracking stills. Construction will be handled by company personnel under supervision of designers of each unit.

• • •

PRODUCTS

Direct use of LPG for motor fuel is gaining. Latest conversion is being made by Boynton Cab Co., Milwaukee, which has had four test cabs in propane operation since September. An additional 25 ca[illegible] of will be converted shortly, at an estimated cos[illegible]sion $130 per cab, not including raising of compr[illegible]ll be ratio, and the firm's entire fleet of 279 cabs converted eventually.

Production of large quantities of high octa[illegible]ne fuels at low price "for the high compression en[illegible]gine we want to build in the future" is the automoti[illegible]e indus-try's most important unsolved chemical [illegible] of Gen-eral Motors Research Laboratories Division, according to C. L. McCuen, general manager [illegible]Speak-ing before a meeting of the Commercial [illegible]Chemical Development Assn. and Chemical Market R[illegible]Research Assn. in Washington, Oct. 4, Mr. McCuen pla[illegible]redicted that with the general availability of high compr[illegible]ession engines an auto owner could be expected to "sav[illegible]640, an average of a gallon a day over present consumption.

Development of a new lubricating oil "that would not change in viscosity from −60 to 300° F., that would be absolutely chemically stable under all engine operating conditions, and that would have low friction characteristics" was another chemical problem posed by Mr. McCuen. "Then," he claimed, "provided we had fuels having clean burning characteristics, we might be able to build a sealed engine which would not require service for its life."

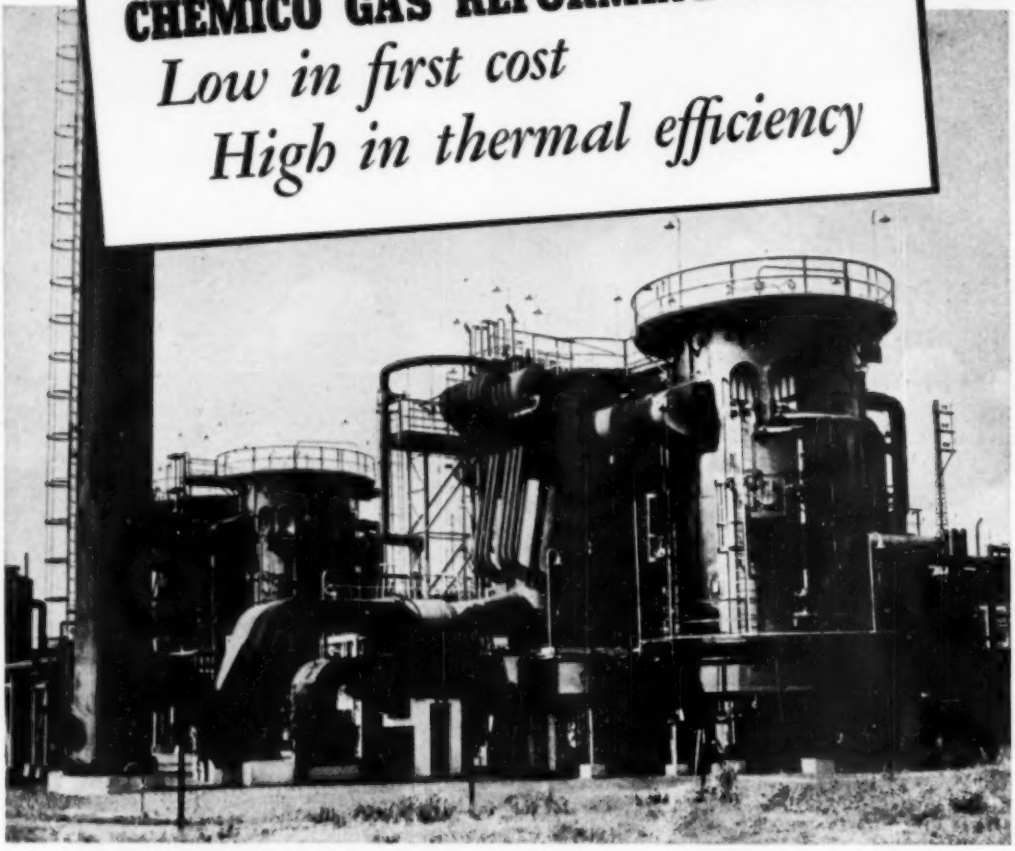
Reclaimed and reprocessed oil must be advertised and labeled as such, according to a provisional order of the Federal Trade Commission issued Oct. 31. The ruling is in the case of Debrol Products Corp., a re-refiner, and Tri-O-Lene Oil Co., it sales subsidiary, both of Chicago. Order becomes final 30 days after service unless appeal is taken to FTC from initial decision of Trial Examiner Frank Hier, or commission itself decides to review the case.

A single all-temperature grade of grease to be used in all Army automotive and artillery applications is

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

CHEMICO GAS REFORMING PLANT

Low in first cost
High in thermal efficiency



Among the many types of heavy chemical plants Chemico designs and constructs are those for the production of synthesis gas, principally hydrogen. The gas reforming plant, shown above, is located in the synthetic ammonia works of the Office National Industriel de l'Azote at Toulouse, France. It has been operating successfully for a year and a half.

Other Chemico installations for the catalytic reforming of natural gas have been producing for as long as eight years. The total output of all these plants is more than 180,000,000 cu. ft. of reformed gas per day. Four more plants are now under construction in the United States and foreign countries.

Chemico's design provides important advantages. These plants are low in first cost, high in thermal efficiency. Construction is simple. The plant is foolproof . . . requires a minimum of operating and maintenance attention.

CHEMICO
GAS REFORMING PLANTS
are used for making:

- **Hydrogen-nitrogen mixtures for ammonia synthesis.**
- **Hydrogen and carbon monoxide mixtures for methanol synthesis.**
- **Carrier gas for blending with natural gas for distribution by Public Utilities.**
- **Hydrogen for industrial uses.**

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

488 MADISON AVENUE, NEW YORK 22, N. Y.

EUROPEAN TECHNICAL REPRESENTATIVE: CYANAMID PRODUCTS, LTD., LONDON W. C. 2, ENGLAND
EUROPEAN LICENSEE OF N. E. C. PROCESS: HYDRO-NITRO S. A., 6 QUAI DU CHEVAL BLANC, GENEVA, SWITZERLAND
CABLES: CHEMICONST, NEW YORK

CC 810

Chemico plants are profitable investments

WHAT'S HAPPENING

Current News Summarized For Oil Men

EXPANSION

Nearly half a billion dollars is being spent this year by the petroleum industry for the development, modernization and expansion of petroleum processing facilities in this country. On the basis of a survey recently conducted by the American Petroleum Institute, $394 million is being laid on the line for new and improved refining facilities, and an additional $74 million for natural gasoline plants—making a total of $468,000,000.

These figures compare to actual average capital expenditures during the past four years (1946-49) of $457 million for refining and $66 million for natural gasoline—a total of $523,000,000 per year.

Imperial Oil Co. plans to start construction late this year on an 11,000 b/d Fluid catalytic cracking unit and a vacuum pipe still at its 20,000 b/d Edmonton, Alberta, refinery. Plant capacity will not be increased. Cost will be about $5,000,000, and completion is scheduled for next fall. Contracts were not yet let as of Nov. 2.

Kerr-McGee Oil Industries at Wynnewood, Okla., is spending $600,000 on remodeling, conversion and additions to its 6,000 b/d refinery to increase plant capacity to 10,000 b/d. Program is scheduled for completion next month.

Standard Oil Co. (Ohio) has begun construction of a new $350,000 waste water separator at its Lima, Ohio, refinery. Arthur G. McKee & Co., Cleveland, is contractor.

Lake Superior Refining Co. has purchased Carter Oil Co.'s 4,000 b/d refinery at Cut Bank, Mont., for re-erection at Superior, Wis., by Feb. 15, 1951. Plant will use Alberta, Canada, crude, with a 2-year option on sufficient crude to support plant capacity increase to 10,000 b/d through addition of catalytic cracking and another crude topper. Refinery Engineering Co., Tulsa, is handling both dismantling and re-erection of the plant; work has started at both points.

Onyx Refining Co., Abilene, Tex., has approved a $650,000 expansion plan to boost present 4,250 b/d crude throughput to 5,500 b/d by June 1, 1951. Principal additions will be a Platforming unit under license from Universal Oil Products Co., and new thermal cracking stills. Construction will be handled by company personnel under supervision of designers of each unit.

• • •

PRODUCTS

Direct use of LPG for motor fuel is gaining. Latest conversion is being made by Boynton Cab Co., Milwaukee, which has had four test cabs in propane operation since September. An additional 25 cabs will be converted shortly, at an estimated cost of $130 per cab, not including raising of compression ratio, and the firm's entire fleet of 279 cabs will be converted eventually.

Production of large quantities of high octane fuels at low price "for the high compression engine we want to build in the future" is the automotive industry's most important unsolved chemical problem, according to C. L. McCuen, general manager of General Motors Research Laboratories Division. Speaking before a meeting of the Commercial Chemical Development Assn. and Chemical Market Research Assn. in Washington, Oct. 4, Mr. McCuen predicted that with the general availability of high compression engines an auto owner could be expected to "save an average of a gallon a day over present consumption."

Development of a new lubricating oil "that would not change in viscosity from −60 to 300° F., that would be absolutely chemically stable under all engine operating conditions, and that would have low friction characteristics" was another chemical problem posed by Mr. McCuen. "Then," he claimed, "provided we had fuels having clean burning characteristics, we might be able to build a sealed engine which would not require service for its life."

Reclaimed and reprocessed oil must be advertised and labeled as such, according to a provisional order of the Federal Trade Commission issued Oct. 31. The ruling is in the case of Debrol Products Corp., a rerefiner, and Tri-O-Lene Oil Co., it sales subsidiary, both of Chicago. Order becomes final 30 days after service unless appeal is taken to FTC from initial decision of Trial Examiner Frank Hier, or commission itself decides to review the case.

A single all-temperature grade of grease to be used in all Army automotive and artillery applications is

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

the Army's goal, Ronald E. Street, office of chief of ordnance, told the National Lubricating Grease Institute Oct. 31. Such a grease, Street said, would have the following approximate characteristics: dropping point, 300° F. minimum; worked peneration, 350 maximum; evaporation, 15% minimum in 22 hrs. at 210° F. bases on ASTM test cell; separation, 4% maximum in 30 hrs. at 160° F.; oxidation stability, 5 psi maximum drop after 100 hrs. at 210° F. and 110 psi initial pressure.

• • •

NEW PROCESSES

A new catalytic reforming process has been developed by Atlantic Refining Co. in co-operation with Davison Chemical Corp., R. L. Hockley, vice president of Davison, revealed last month in a talk before the New York Society of Security Analysts. The undisclosed catalyst for the process is manufactured by Davison. Hockley claims that the new process and catalyst appear to have broad applications and to be a substantial improvement over other reforming processes. The process "could have a very important part to play in helping overcome the current benzol shortage," he stated.

Another new catalytic reforming process was announced—at annual meeting of Socony Vacuum manufacturing and technical personnel in Los Angeles Nov. 2. A 50 b/d semi-commercial unit has been operating at Socony's Paulsboro laboratories since last spring, and a commercial-size unit is now being designed, according to the company. Further details are expected to be released shortly.

Cyclization of n-hexane to benzene and other aromatics has been conducted sucessfully on a laboratory scale by the University of Kansas Research Foundation. Relatively high yields have been achieved—21.6 vol. % benzene on a once-through basis, with 38.4 vol. % of a mixture of hexane and olefins available for recycling. Chromia-alumina catalyst was used, the reaction carried out at atmospheric pressure and 510° C.

• • •

FOREIGN

Chilean government has engaged Hudson Engineering Corp. to build a $3,000,000 oil and gas processing plant on the island of Tierra del Fuego, south of the Straights of Magellan. The plant will process 30,000,000 cu. ft. of gas and 6,000 bbls. of crude daily. Butane and heavier hydrocarbons will be extracted from the gas, and stripped gas returned to the field for pressure maintenance. The light fractions which would be lost from the crude oil through evaporation during tanker transportation will be stripped from the crude oil. Stable liquid hydrocarbons extracted from the gas will be blended with the stripped crude. Plant is expected to be placed in operation in June, 1951.

Rehabilitation of nine Japanese refineries on its East or Pacific Coast has been virtually completed, according to J. K. Kelsey of Standard-Vacuum Oil Co., New York. Output of these plants (28,100 b/cd of crude and topped crude was run to stills in July), coupled with that of "indigenous" refineries, meets minimum requirements of the Japanese economy, except for gas oil and lubricants. Kelsey served from February through August as refining consultant with the Supreme Command of the Allied Powers.

• • •

MARKETS, PRICES

Prices broke out on the upside during October along the Eastern Seaboard and on the West Coast. However, despite these advances, quotations of refiners and terminal operators were regarded by many trade sources as "more vulnerable" than for several months.

In general, inventories were building rapidly in most East-of-Rockies refining and terminal districts, and refiners alro were aware that there already was more heating oil in resellers' and consumers' tanks this season that in recent years.

Rates for water transportation and shortages of clean and dirty tank cars frequently were causing material to back up somewhat, principally at the Gulf and in the Mid-Continent. In addition, refiners who have been building fuel oil supplies against the months when demand would outrun their ability to produce were plagued by U. S. weather forecasts of a long Indian Summer in the Midwest.

Three advances were posted for crude oils. South Penn Oil Co. and other buyers boosted prices for Pennsylvania-grade crudes 10c per bbl., the fifth 1950 advance, which put Bradford crude at $4.10 per bbl. On the West Coast, California Standard advanced its buying prices for 14 gravity crudes by 10c per bbl., with lesser increases for higher gravities. Six days later, Union Oil hiked 14 gravity crude prices 25c per bbl. in all fields where it buys. The latter's heavy crude prices are now 25c per bbl. above California Standard's.

California Standard also made a general increase, ranging from 0.2 to 0.4c per gal., in its prices for gasoline and other light products throughout its western marketing territory.

Increased tanker transportation rates were cited by suppliers as prompting advances for distillates on the East Coast. Distillates generally were priced 0.5c per gal. higher following advances in mid-month by Socony-Vacuum, Esso Standard, Atlantic, Kentucky Standard and other major and Independent suppliers. The generally posted barge price for kerosine at New

York harbor was 10c and 9c for No. 2 fuel.

Tanker rates substantially above mid-summer levels also were named by Gulf and several other suppliers in making a general boost in heavy fuel prices ranging from 10 to 15c per bbl. on Oct. 7 at terminals from Maine to Florida. However, these advances failed to follow through with other large suppliers. Late in the month, Gulf rescinded its increase, and quoted $2.15 barges for No. 6 fuel at New York, Philadelphia, Baltimore and Norfolk.

Even lubes were loosening up, whereas previously they had been the tighest products on the list. While strong demand for lubricants was indicated for some time because of military purchases, it was becoming apparent that some resellers had overstocked at first news of the Korean war.

• • •

MISCELLANY

Refinery wage questionnaire has been drawn up by Labor Department, and details for the survey completed. Mailing to every U. S. refiner is expected soon. Result of survey—which will establish a minimum wage under Walsh-Healey Public Contracts Act for refiners handling government orders of more than $10,000—probably will not be tabulated before the end of the year.

Strike notices may be mailed and do not have to be served personally, according to a national Labor Relations Board trial examiner's finding—one which may be precedent-setting. Examiner P. F. Ward ruled that Oil Workers International Union (CIO) complied with Taft-Hartley Act and its bargaining contract when it mailed a strike notice to Tide Water Associated Oil Co., San Francisco.

Ward said the union mailed the strike notice in time for delivery on the first day its contract with Tide Water provided it could be given. Tide Water was late in receiving the notice because its office was not open for receipt of mail the first day the post office attempted to deliver the notice. Knowing from the terms of the contract that such a notice might be forthcoming, Ward said, the company should have made arrangements to receive the mail containing it.

• • •

INDUSTRIAL MOBILIZATION

Petroleum Administration for Defense was established by Interior Secretary Chapman Oct. 2 to run the oil and gas phase of his defense program job. PAD will operate as an independent agency, with a deputy administrator in operating charge and responsible for his actions only to the secretary, as administrator. Bruce K. Brown (president, Pan-Am Southern Corp.) has been recommended as deputy administrator, but temporarily Chapman has named Hugh A. Stewart acting deputy administrator. Organization of PAD is being patterned almost exactly after that of World War II Petroleum Administration for War. A staff of more than 300 on the job by early 1951 is present aim.

Avgas requirements of military will probably be up during first half 1951, despite figures recently released by Armed Services Petroleum Purchasing Agency. ASPPA figures indicate that demand during first half 1951 will be 23,698,000 bbls., compared to demand of 24,582,000 bbls. during current six months. The sleeper: ASPPA's figures are based on what the military thinks it can buy with what money there is already on hand. If Congress goes through with its preparedness program—almost a certainty—then it will appropriate more money—and the military will correspondingly revise its requirement figures upwards.

Navy fuel requirements for first half 1951 are up sharply from last half of this year, according to bid invitations sent out last month. Quantities of fuels required (with figures for last half of 1950 in parentheses) are as follows, in 1,000's of bbls.: East Coast-Gulf Coast-Caribbean area—Navy Diesel, 1,610 (175); Navy Special Fuel Oil, 7,300 (4,070); West Coast—Navy Diesel, 1,340 (830); Navy Special Fuel Oil, 6,600 (5,000).

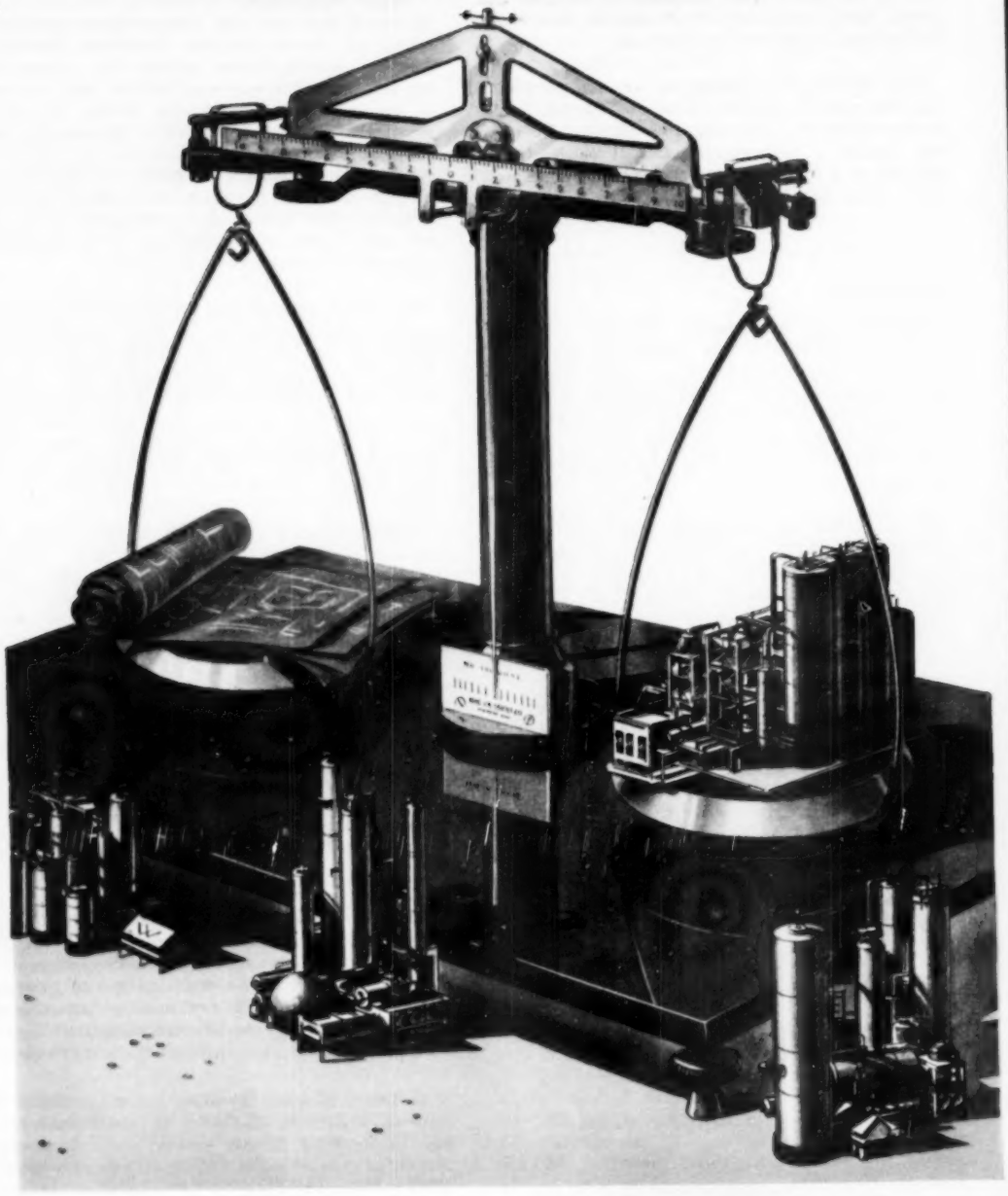
Military motor gasoline needs for cargo lifting during first six months of 1951 are up 30%. Total of 2,410,000 bbls. compares with approximately 1,640,000 bbls. being taken in current six months. Bulk is grade 74, with only 400,000 bbls. grade 80/86 needed.

Applications for fast tax "write offs" are being handled through National Security Resources Board, under authority delegated by President Truman Oct. 13. Under Defense Production Act, investments after Dec. 31, 1949, in new plants and facilities used in mobilization program can be amortized over a 5-year period instead of normal 20 to 30 years. Application forms and information on fast "write offs" are available from NSRB or any Commerce Department field office.

Aluminum producers have been directed by National Production Authority (order M-5, issued Oct. 27) to accept priority rated (DO) order for as much as 25% of output. NPA was expected to issue another aluminum order the first week in November restricting non-defense use of aluminum to 65%—and possibly lower—of present "normal" requirements.

An Office of Small Business has been formed by National Production Authority to assist small business in obtaining defense contracts and in keeping abreast of defense needs. Head of the newly-created office is Edward H. Lane.

"Guesstimate"



or ESTIMATE

Before considering plant expansion or new construction, manufacturers in the process industries must have assurance today that the final cost of a new plant will bear reasonable relationship to the initial appropriation.

Badger is able to give valuable assistance in making rational and adequate estimates of cost, based on current experience in the design and construction of similar plants in all parts of the world.

Badger's realistic cost estimates are backed by proved ability to handle in time and money saving scheduled sequence the myriad details involved in the design, engineering and erection of all types of process plants for the petroleum, chemical and petro-chemical industries.

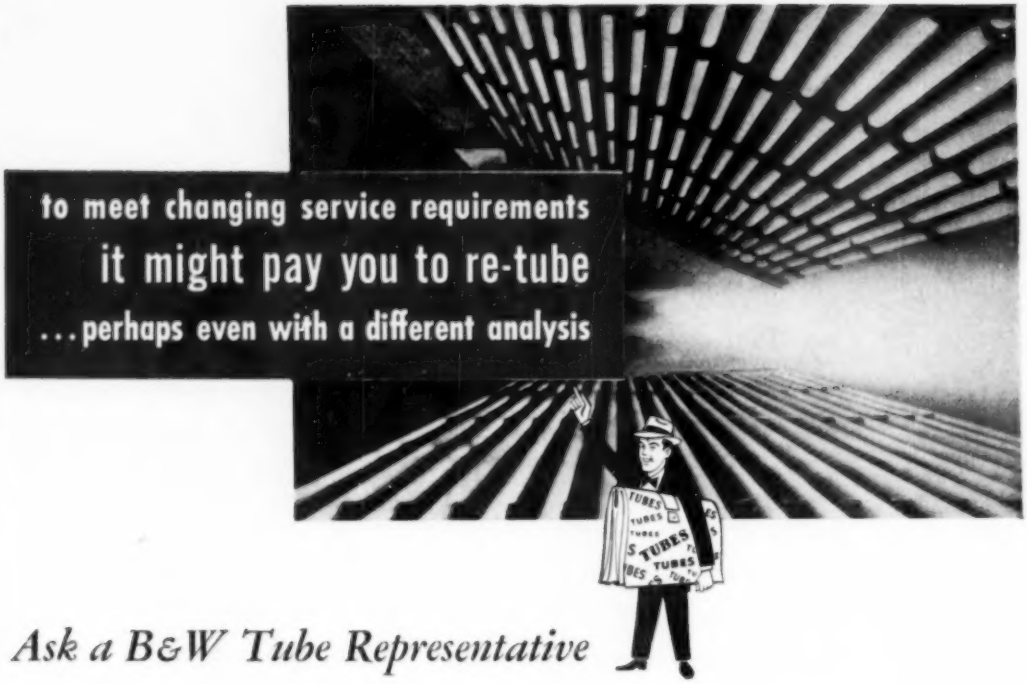
E. B. BADGER & SONS CO · Est. 1841

A SUBSIDIARY OF STONE & WEBSTER, INC.

BOSTON 14 · NEW YORK

PARIS Etablissements Badger S.A. · LONDON E. B. Badger & Sons (Great Britain) Ltd.

Process Engineers and Constructors for the Petroleum, Chemical and Petro-Chemical Industries



Ask a B&W Tube Representative

B&W REFINERY TUBING

. . . a wide choice of service-proved analyses* to meet *all* conditions of pressure, temperature, corrosion and oxidation.

Carbon Steel	
Carbon Moly Steel	(½% Mo)
Croloy ½	(½% Cr, ½% Mo)
Croloy 1¼	(1¼% Cr, ½% Mo)
Croloy 2	(2% Cr, ½% Mo)
Croloy 2¼	(2¼% Cr, 1% Mo)
Croloy 3-M	(3% Cr, 1% Mo)
Croloy 5	(5% Cr, ½% Mo)
Croloy 5-Si	(5% Cr, ½% Mo, 1½% Si)
Croloy 5-Ti	(5% Cr, ½% Mo, ½% Ti)
Croloy 7	(7% Cr, ½% Mo)
Croloy 9-M	(9% Cr, 1% Mo)
Croloy 18-8-S	(18% Cr, 8% Ni)
Croloy 16-13-3	(16% Cr, 13% Ni, 3% Mo)
Croloy 25-20	(25% Cr, 20% Ni)

*The above list indicates only the more popular B&W Tubing Steels for Refinery Service and does *not* constitute the complete range of grades in which B&W Tubing is produced.

Today's diversity of petroleum processing operations imposes a greater variety of requirements than ever before on alloy and stainless refinery tubing . . . makes proper selection of analyses increasingly difficult. Your B&W Tube Representative may be able to show you . . .

FOR EXAMPLE

. . . how, in a given service, re-tubing with certain lower grades can give savings in initial cost without materially affecting performance; or how, under different conditions, switching to a higher alloy can pay service dividends far beyond a negligible increase in cost. Consult *your* B&W Tube Representative—his factory training in cost-saving "tube technics" and broad knowledge of refinery applications can help you decide whether you are expecting too *much* . . . or too *little* . . . from your present tubing.

B&W SEAMLESS and WELDED TUBES

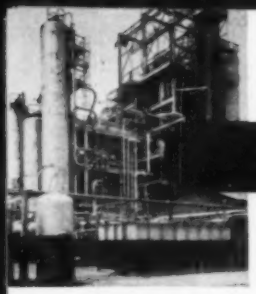
THE BABCOCK & WILCOX TUBE COMPANY

General Offices: Beaver Falls, Pa.

Plants: Alliance, Ohio, and Beaver Falls, Pa.

Sales Offices: Alliance, Ohio • Beaver Falls, Pa. • Boston 16, Mass. • Chicago 3, Ill. • Cleveland 14, Ohio • Denver 2, Colo. • Detroit 26, Mich. • Houston 2, Texas • Los Angeles 15, Calif. • New York 16, N. Y. • Philadelphia 2, Pa. • St. Louis 1, Mo. • San Francisco 3, Calif. • Syracuse 2, N. Y. • Toronto, Ontario • Tulsa 3, Okla. • Vancouver, British Columbia

TA-1578-S



TOMORROW... IN PETROLEUM TECHNOLOGY

DuPont Promotes Use of Alcohol-type Antifreezes

THOSE who have been following the steadily upward trend in the demand for "permanent-type" antifreezes—chiefly ethlyene glycol, propylene glycol, or their mixtures—probably have been rubbing their eyes in disbelief, this fall, at advertisements of one of the major producers of both "permanent" and alcohol antifreezes—E. I. du Pont de Nemours & Co., Inc. That company has been informing motorists that its alcohol antifreezes (at $1.25 per gallon) are adequate and economical for use under all but the most severe of winter climes, and that motorists should use glycol antifreezes (at $3.60 per gallon) only in temperature conditions encountered rarely in this country, and then only in the northerly regions.

To be exact, Du Pont has advised motorists to use its Zerone (alcohol antifreeze) instead of Zerex (its glycol antifreeze) unless the latter is to be used for service below −30° C. (−22° F). Some of its releases state that this advice is based on tests conducted over long periods of time, and that the company has found that the thermostat settings on modern automobiles are such that the motorist is protected against boiling away of the alcohol-type antifreezes.

Actually, it is quite possible that motorists have been overdoing the use of the permanent-type antifreezes, but the feeling of safety offered by their use has lulled many motorists into closing their eyes to comparative economics. Not that even the permanent-type antifreezes are "perfect"—as many a driver with a 99.999% water-tight (or rather glycol-tight) radiator has found to his sorrow.

However, tests conducted by many companies, and reported on many occasions, have all pointed to a wide utility—technical utility—for the permanent-type antifreezes, and this has been confirmed in several publications of the National Bureau of Standards. As regards thermostat settings on automobiles, moreover, engineers have pointed to the fact that the thermostats do not prevent a surge in coolant temperatures when engines are shut off and that the temperatures so reached are above the boiling points of adequate-strength alcohol antifreezes, also that motorists using hot-water type car heaters often have their thermostat settings increased to the danger point as regards evaporation of alcohol antifreezes.

It is possible, of course, that this whole argument may become partially academic if military and aviation demands drain off a large portion of the available supply of glycols, but glycol production in 1950 is expected to reach an all-time high of about 54,000,000 gals., so that motorists will probably be able to fill their radiators with permanent antifreeze this winter if they so desire—and next winter, too, unless essential demands channel off an unexpectedly large fraction of ethylene glycol or its intermediates.

The latter, incidentally, may afford a clue to Du Pont's motive. Ethylene glycol itself is an intermediate in the synthesis if Fiber V, DuPont's highly promising new fiber which may soon go into commercial (or at least semi-commercial) production, and ethylene glycol itself is produced (by some companies, at least) from ethylene oxide, which is an intermediate in one method for the synthesis of acrylonitrile, which DuPont needs for the production of its Orlon synthetic fibers—already in production.

Whatever its motive DuPont has certainly raised an issue which will cause many motorists—and commercial users of antifreezes—to think twice. Other producers of permanent-type antifreezes may counter with advertisements of their own. At the least, more experiments will be conducted, or old ones carefully reviewed. To the petroleum and petroleum-chemical industry, the whole matter is of far more than academic interest.

Tetraethyl Lead Supplies Ample for Emergencies

IN these days of higher-compression-ratio cars and high-octane-number gasolines, only the Korean conflict and the threat of future war seem to stand between the motorist and his dream of a car which combines power with economy. Of course, there *is* the fact that a large segment of the petroleum industry must drastically alter its plants to produce the necessary fuels, while the automotive industry must continue to improve its engines by incorporating mechanical octane numbers along with increased compression ratios. But the trend is there, and preparedness efforts will only postpone, not break it.

Under these circumstances, and until and unless a major conflict intervenes, it may well be expected that competition will see to it that refiners will continue to bend every effort to maintaining or improving the octane numbers of their gasolines, within the limitations imposed by military demands for alkylate and other high-octane materials. This will mean continued refinery expansion, insofar as materials and priorities are available. More to the point, it will mean more use of tetraethyl lead—to the limit of availability of this potent additive.

Fortunately, supplies of tetraethyl lead will continue to grow. The major producer, Ethyl Corp., has greatly increased its capacity since the end of World War II, while Du Pont, a market entrant in 1948, has also increased its potential. Ethyl, moreover, has only recently announced plans for the construction of a complete production plant in Texas, to supplement its large plant at Baton Rouge, Louisiana.

Because of the potential increase in the availability of tetraethyl lead, Ethyl apparently does not share in the gloomy predictions that, in an emergency, the octane number of "civilian" gasolines will have to fall to the levels prevalent in World War II. Graham Edgar, vice-president of Ethyl, has recently pointed out that the present production capacity for TEL is 350,000,000 lbs. per year, far greater than that of World War II, and that this figure will increase to 460,000,000 annually by 1952. Moreover, Edgar reminds the industry that, in view of the increased importance of turbojet and turboprop engines, which do not require incorporation of tetraethyl lead, "it seems most improbable that the demand for aviation gasoline (in an emergency) will exceed that of World War II, and the longer an emergency is postponed, the less the (military) demand for tetraethyl lead would appear to be."

In his prediction,[1] Edgar states that he anticipates no shortages of raw materials for the production of TEL in any predictable emergency. While he certainly does not predict

that tetraethyl lead can carry the full burden of replacing the high-octane stocks which will be diverted to war uses, he does feel that it can at least partially offset the trend (in an emergency) to decidedly lower octane numbers.

Incidentally, in a recent study of preignition characteristics of combustion chamber deposits, conducted in a full-scale, single-cylinder engine, A. Hundere[2] of the California Research Corp. found that: "1—lead deposits are incapable of supporting preignition of sufficient advance to have any harmful effect; 2—certain compounded oils contain materials that on burning in the combustion chamber leave deposits capable of supporting destructive preignition; 3—any fuel or oil constituents that on combustion leave deposits having a melting point of about 2,000° F. can cause incipient preignition, and, if the melting point is above about 2,500° F., destructive preignition can result; 4—metals present in the oil from normal engine wear are insufficient in quantity to cause harmful preignition; and 5—there is much that can be done to alleviate the lead fouling of spark plugs without reducing the lead content of the fuel or developing an improved scavenger."

Increased lead contents will bring problems with them, but ones which are susceptible to solution. In any case, it is encouraging to note that more tetraethyl lead will be available to meet the ever-growing demands.

Valve Makers Standardize Face-to-face Dimensions

EQUIPMENT standardization has long been an aim of many who are concerned with the design, operation, and maintenance of petroleum processing plants. Another step forward in the right direction was taken recently when official information was released that all major control valve manufacturers and a number of smaller manufacturers now are able to supply flanged control valves in up to 8-in. pipe sizes conforming to the standard face-to-face dimensions shown in Table 1.

This accomplishment was the result of the joint efforts of the Instrument Society of America and the National Steam Specialty Club. Historically, the work began over three years ago at the first meeting of the ISA Recommended Practices Committee in Cleveland, April 23, 1947. A sub-committee assignment was made at that time, with W. H. Fortney, Humble Oil & Refining Co., Baytown, Texas, as chairman, to develop recommended practices in regard to control valves and by-pass installations. A questionnaire circulated to the user industries shortly thereafter brought a firm "Yes" to the query: "Are you of the opinion that the various manufacturers of control valves should get together and standardize on the face-to-face dimensions of their valves?"

In September, 1947, the ISA Recommended Practices Committee asked Anker Krogh, Brown Instrument Co., the liaison member of the Scientific Apparatus Makers Association, to advise the manufacturers of this unanimous feeling. After considering which manufacturers' organization had the maximum representation of control valve producers, the National Steam Specialty Club was finally selected.

There then followed a series of joint and separate meetings of the two groups for many months, resulting in the final acceptance by the NSSC of face-to-face body dimensions for flanged end valves of both cast iron and steel through 400 psi. flange ratings. Sizes were ½ through 8 in., not including 1¼, and 5 in. because of their infrequent use.

The British Standards Institute indicated in the summer of 1948 that they have an industry committee working on the same problem and they desire to coordinate their efforts with the Americans. Contacts have continued between these two.

The dimensions are now being considered for official endorsement by the ISA Recommended Practices Committee, but this is expected to be only a matter of formality.

TABLE 1—Uniform Face-to-Face Dimensions for Flanged Control Valve Bodies

Pipe Size inches	125 psi. Iron 150 psi. Steel*	250 psi. Iron 300 psi. Steel†	600 psi. Steel‡
½		7½	8
¾		7⅝	8½
1	7¼	7⅝	8¼
1½	8½	9¼	9⅝
2	10	10½	11¼
2½	10⅝	11½	12¼
3	11⅝	12½	13¼
4	13⅝	14½	15½
6	17⅝	18⅝	20
8	21⅝	22⅝	24

* Cast iron bodies with 125 psi. ASA, B16A-1939 flanges, and steel bodies with 150 psi. raised face ASA B16E-1939 flanges.

† Cast iron bodies with 250 psi. ASA B16B-1944 flanges, and steel bodies with 300 psi. raised face ASA B16E-1939 flanges.

‡ Steel bodies with 600 psi. raised face ASA B16E-1939 flanges.

Petroleum May Be Selected To Augment Benzene Supply

DESPITE the efforts of the Bureau of Mines to advance the cause of coal hydrogenation by advocating the erection of a huge plant to produce benzene as a by-product, it now appears that Government agencies concerned with the supply and uses of benzene have come to the logical conclusion that increased production in this country can best be obtained from petroleum.

A recent estimate for the 1950 production of benzene from coal tar sources placed this figure at 165,000,000 gals., "insufficient to meet the needs of consuming industries, despite the augmenting of supplies by (at present) limited petroleum production and higher-than-normal imports."[3] Because of the seriousness of the situation, benzene was one of the first materials placed under NPA Regulation No. 1 inventory control, and its allocation seems certain.

Late in September, moreover, benzene prices increased 5c per gal. throughout most of the industry, to 30c per gal. at most producing points. Incidentally, *Modern Plastics*[4] reports that manufacturers of plastics in Great Britain "are not too pleased with the recent agreement to export 22,000,000 gals. of benzene a year to the United States for styrene production," since raw materials for the production of plastics are also in short supply in Great Britain.

It has recently been pointed out[5] that "we are urgently in need of benzene and other aromatics from sources independent of the coking rate for the manufacture of steel. The construction of new coke ovens continued at a lively pace last year. Some 470 ovens were added, with a capacity of 2,275,300 tons of coke annually, but the Bureau of Mines finds that in spite of this new construction the total number and annual coke capacity of slot-type ovens actually was lower at the end of 1949 than at the beginning. New construction, in other words, did not keep pace with obsolescence and old oven failures." Moreover, *Business Week*[6] reports that "more than half of all by-product coke ovens are more than 20 years old and probably will have to be shut down and rebuilt pretty soon."

In the last war, toluene was the aromatic hydrocarbon whose production from petroleum was of vital importance; in the present crisis, benzene has been added to the list.

References

1. *Wall Street Journal*, September 15, 1950, p. 5.
2. *Automotive Industries*, September 1, 1950, p. 62.
3. *Oil, Paint and Drug Reporter*, August 28, 1950, p. 44.
4. *Modern Plastics*, September, 1950, p. 146.
5. *Industrial and Engineering Chemistry*, September, 1950, p. 16A.
6. *Business Week*, September 16, 1950, p. 72.

NEW SANTOPOID 33

simplifies gear lubricant production and inventory

Santopoid 33 meets specification MIL-2105

NEW Santopoid 33, developed by Monsanto Research and thoroughly tested in the laboratory and in field service, is available now to help you simplify both production and inventory.

Blended with suitable base oils, Santopoid 33 permits you to make a multipurpose gear lubricant that thoroughly protects gears in all automotive final drives and most transmissions. In addition, Santopoid 33 enables you to blend suitable lubricants for all types of industrial gear assemblies. Made with Santopoid 33, lubricants withstand the high-speed cruising of passenger cars and the low-speed, extreme-pressure requirements of tractors and trucks.

Gear lubricants blended with Santopoid 33 have tough films. They are stable and noncorrosive at all temperatures likely to be encountered in service. Santopoid 33 and the oil do not separate nor stratify and do not precipitate metallic salts.

Investigate the possibilities offered by Santopoid 33—newest member of Monsanto's complete line of petroleum additives. Learn how it can help you to make a superior lubricant for use in *all types of gears*. For information, mail the coupon or contact MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1746-L South Second Street, St. Louis 4, Missouri.

MONSANTO PETROLEUM ADDITIVES

SANTOPOUR*
SANTOPOUR B
SANTOPOUR C
Pour point depressants.

SANTOLUBE* 395, 395-X, 398, 394-C
Motor oil inhibitors.

SANTODEX*
Viscosity index improver.

SANTOPOID* S, S-R1, 29, 30, 32, 33
Gear lubricant additives to meet requirements of Federal specification VV-L-761 and Military specification MIL-2105.

SANTOLUBE 293-A, 393-A, 529
Motor oil detergents.

SANTOLENE* C
Rust inhibitor.

SANTOLENE E
Fuel oil sludge inhibitor.

SANTOLUBE 52
Cutting oil additive.

INHIBITOR-DETERGENT COMBINATIONS
for premium and heavy-duty service, including Santolubes 205, 206, 360, 374, 379, 521, 522.

*Reg. U. S. Pat. Off.

MONSANTO
CHEMICALS – PLASTICS

MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
1746-L South Second Street, St. Louis 4, Missouri

Please send information on NEW Santopoid 33 and on .....

Name ..... *Title* .....
Company .....
Street .....
City ..... *Zone* ..... *State* .....

SERVING INDUSTRY . . . WHICH SERVES MANKIND

Glass manifolds from single cylinder engines demonstrate the lessened deposit-forming tendency of Oil Blue A. Observe the small amount of deposit found in No. 1 (using Oil Blue A), compared to No. 3 in which the old Oil Blue was used. Yet the original color strength of the two gasolines tested was the same. The relatively small deposit found in No. 1 is the result, not only of the reduced deposit-forming tendency of Oil Blue A, but also of its considerably higher tinctorial strength.

No. 1 operated on gasoline containing .5 gram Oil Blue A/100 gal. gasoline.

No. 2 operated on gasoline containing 1.0 gram Oil Blue A/100 gal. gasoline.

No. 3 operated on gasoline containing .75 gram Oil Blue/100 gal. gasoline.

DuPont Oil Blue A

Gives Desired Color Intensity with Lower Concentrations

If you use a blue dye in your gasoline, and particularly if you are producing civilian aviation gasoline, you should investigate the economy and lessened deposit forming advantages of Du Pont Oil Blue A. Meeting the requirements of Specification MIL-F-5572, it may also be used in aviation gasolines intended for military use. It is approximately 35% stronger than the previous Du Pont Oil Blue, several times as soluble, and can be used in lower concentration to obtain the desired color intensity.

Easier to use, Du Pont Oil Blue A comes in a non-caking, free-flowing, highly soluble crystalline form, thus simplifying the preparation of stock solutions or the direct dyeing of gasoline.

Ask your Du Pont Petroleum Chemicals representative for samples and complete information, or write the nearest Petroleum Chemicals District Office.

Ask your Du Pont Petroleum Chemicals representative for a copy of this bulletin on Du Pont Oil Blue A. It contains complete specifications, suggested blending schedules, and test results.

DU PONT

Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

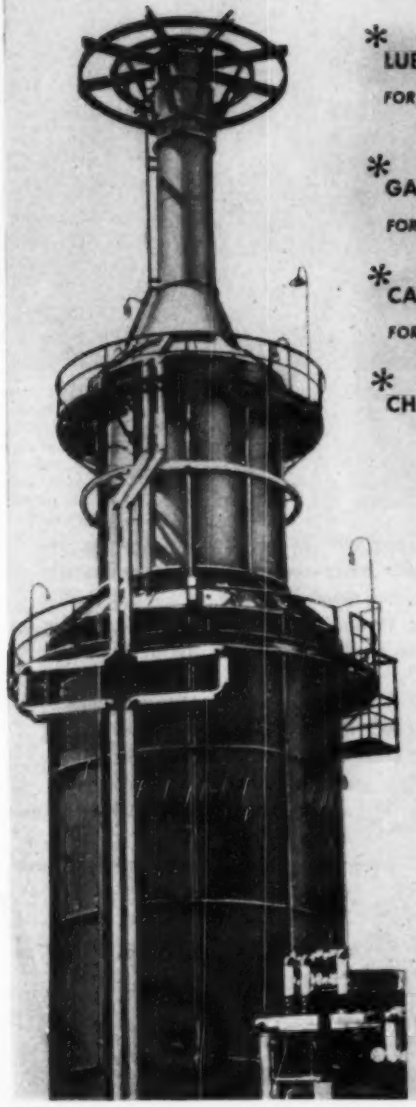
Make Du Pont the Source for All of Your Gasoline Additives . . . Tetraethyl Lead Compounds (Motor Mix—Aviation Mix)—Antioxidants—Metal Deactivator—Dyes

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

District Offices: New York, N. Y. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · Los Angeles, Calif.

District Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · El Monte, Calif.

THERE'S A PETRO-CHEM ISO-FLOW FURNACE FOR EVERY CAPACITY, SERVICE AND DUTY



*** LUBE OIL PLANT HEATERS**

FOR Crude Distillation • Vacuum Distillation • Solution Rerunning
Raffinate Extraction • Asphalt and Deasphalting
Filtrol Distillation • Contact Clay Treating

*** GAS AND GASOLINE PLANT HEATERS**

FOR Gas Dehydration and Reactivation • Reboiling
Heat Medium Circulating • Rich Oil • Diethylene Glycol

*** CATALYTIC PLANT HEATERS**

FOR Light and Heavy Gas Oil Heating
Atmospheric and Vacuum Feed Preparation • Reforming

*** CHEMICAL PLANT HEATERS**

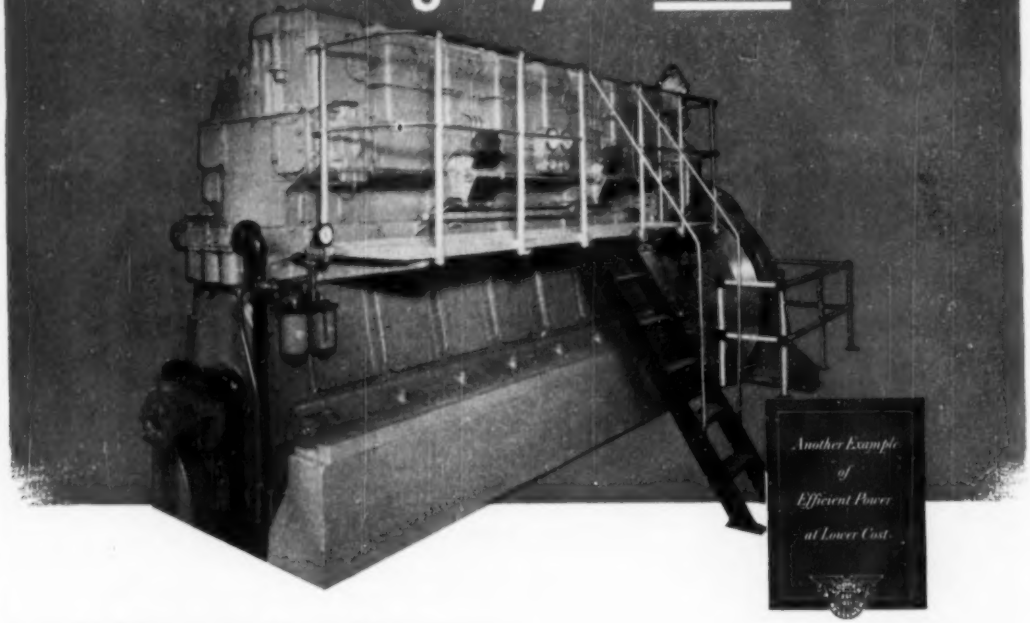
FOR Gas Cracking • Gas Synthesis
High Temperature Superheating • Steam and Air

*** FROM 1 TO 70 MILLION BTU'S WITH EFFICIENCIES UP TO 85%**

YOU NAME YOUR PROCESS CONDITIONS and we'll tell you where there is a Petro-Chem Iso-Flow Furnace operating to meet your requirements . . . of the many hundreds now in successful operation, most Petro-Chem Iso-Flow* Furnaces operate beyond their design ratings.*

PETR CHEM
ISO-FLOW FURNACES
UNLIMITED IN SIZE CAPACITY DUTY
PETRO-CHEM DEVELOPMENT CO., INCORPORATED
120 EAST 41ST STREET, NEW YORK 17, N. Y.
Representatives: Bethlehem Supply, Tulsa and Houston - Flagg, Brackett & Durgin, Boston - D. D. Foster, Pittsburgh - Fayne-Levally, Chicago - Lester Oberholtz, California

Fuel oil makes up for the gas you don't have!



Licking an old problem . . . .

Cooper-Bessemer gas-diesels are licking an old problem in field pumping and drilling operations. Where gas fuel is not available at the outset, wherever gas *is* available but in varying volume, these engines are ideal. Here's why . . .

They thrive on virtually *any* combination of oil and gas or on 100% fuel oil. They even adjust automatically for the slightest variation in gas supply. Thus you can always make maximum use of waste or low-cost gas, starting or falling back on full or partial oil operation as required.

That's not all! Recent Cooper-Bessemer refinements make these engines sensationally economical *even at fractional loads* . . . the highest thermal efficiencies ever reached in practical heat engines. The gas goes farther!

Why not get complete, specific information as applied to your conditions? The nearest Cooper-Bessemer office will be glad to explain how you can save . . . *and save!*

The
Cooper-Bessemer
Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York City Washington, D. C. Bradford, Pa. Parkersburg, W. Va.
San Francisco, Calif. Houston, Dallas, Greggton, Pampa and Odessa, Texas
Seattle, Wash. Tulsa, Okla. Shreveport, La. St. Louis, Mo. Los Angeles, Calif.
Caracas, Venezuela Gloucester, Mass. Calmes Engineering Co., New Orleans, La.

LETTERS

Capacity Cushion

I liked the lead editorial from your September issue [p. 1012] with respect to refining capacity probably being "thinner than you think." I think the reasoning in the editorial is good, and I might add here that in a discussion of refining capacity which occurred even as much as three or four months ago, which, you will remember, was before Korea, I made the statement that if the then existing economic conditions continue to exist, I wouldn't be surprised if we saw another wave of refinery construction.

FRED VAN COVERN
Director
Department of Statistics

American Petroleum Institute
New York, N. Y.

Refinery Expansion

I enjoyed very much reading the article [on refinery expansion, September PP, p. 933]. It is a good job of forecasting what may happen in the petroleum industry for the next 10 years, particularly in refining.

I noticed that in Fig. 1 you did not plot your own estimates for 1960 demand. You probably have noticed that they are only very slightly below the low figures for the Bureau of Mines for that year. If my memory serves me correctly, our projection for the low values was based on 3 or 4% per year and for the high values around 6%. I still think this is quite reasonable. I note that you did not refer to the recent article by George R. Hopkins concerning the demand for oil and supply for the next 20 or 25 years. It was published in the *Journal of Petroleum Technology*, June 1950, and to my mind is a very thoughtful analysis of the petroleum picture.

W. C. SCHROEDER
Chief, Synthetic
Liquid Fuels Branch

U. S. Bureau of Mines
Washington, D. C.

Lubrication Losses

May I express my admiration of the cutting and rewrite job done on the paper ["10 Ways to Stop Losses in Lubricating Plant Equipment," October PP, p. 1068]. All of us have at times suffered a shears and paste pot job that made the writer look like a moron. Your editing, on the contrary, improved the original article for the purpose of magazine publication. Many thanks.

L. F. JAHNKE

Socony-Vacuum Oil Co.
New York, N. Y.

Safe-all the Way
One of a series of typical Propane Truck Loading Racks
CHIKSAN Style 50 A-S Counterbalance Swivel Joint
OKADEE L. P. G. Valve
WECO Wing Union
WECO Hi-Speed Thread Seal

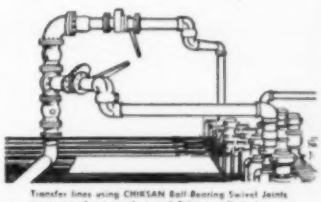
Eliminate *all* the weak spots in your L. P. G. loading racks! Use CHIKSAN *Ball-Bearing* Swivel Joints, WECO Wing Unions, *Okadee* Valves and WECO *Hi-Speed* Thread Seal...and get *matched* safety all the way... plus dependable performance, low maintenance cost, easy handling and long life.

Wherever you handle liquids, vapors or gases through flexible lines, this engineered combination saves you time and money. CHIKSAN Engineers will gladly assist you in designing flexible lines for the safe handling of a wide range of products...in any length...any size...any pressure to 15,000 psi.

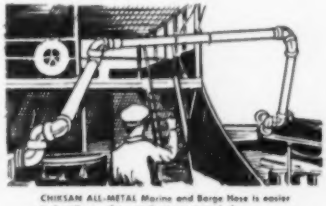
REPRESENTATIVES IN PRINCIPAL CITIES

SOLD BY LEADING SUPPLY STORES EVERYWHERE

Play safe *all the way!* Use CHIKSAN *Ball-Bearing* Swivel Joints to make up your loading and unloading lines. With them, you get unlimited flexibility with the strength, long life and safety of steel. You get greater protection...greater safety ...and greater economy with CHIKSAN.



Transfer lines using CHIKSAN Ball-Bearing Swivel Joints save cost of extra valves and fittings... eliminate contamination losses.



CHIKSAN ALL-METAL Marine and Barge Hose is easier to handle... safer... and more economical.

WRITE FOR CATALOG NO. 50

CHIKSAN TRADE MARK REG.

CHIKSAN COMPANY
AND SUBSIDIARY COMPANIES
Chicago 3, Ill. BREA, CALIFORNIA Newark 2, N. J.
WELL EQUIPMENT MFG. CORP. HOUSTON 1, TEXAS
CHIKSAN EXPORT CO. BREA, CALIFORNIA NEWARK 2, N. J.

BALL-BEARING SWIVEL JOINTS FOR ALL PURPOSES

IN JUST
ONE YEAR!

THESE *EIGHT* REFINERS HAVE CHOSEN THE

PLATFORMING

PROCESS

OLD DUTCH REFINING COMPANY
Muskegon, Michigan

KENDALL REFINING COMPANY
Bradford, Pennsylvania

JOHNSON OIL REFINING COMPANY
Cleveland, Oklahoma

BELL OIL AND GAS COMPANY
Grandfield, Oklahoma

MID-WEST REFINERIES, INC.
Alma, Michigan

AURORA GASOLINE COMPANY
Detroit, Michigan

PREMIER PETROLEUM COMPANY
Fort Worth, Texas

ONYX REFINING COMPANY
Abilene, Texas

Can you, as a refiner, ask for more conclusive proof of this process as a possible solution to your vitally important problem of product improvement?

UNIVERSAL OIL PRODUCTS COMPANY

UOP

General Offices: 310 S. MICHIGAN AVENUE, CHICAGO 4, ILLINOIS, U. S. A.
Laboratories: RIVERSIDE, ILLINOIS

Universal Service Protects Your Refinery

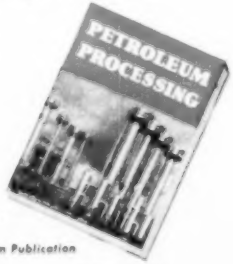
Delivered at Home...

where a man has time to read!

Refinerymen like *Petroleum Processing*'s home delivery. It gives them the expert know-how they need, at the time and place they can study best. And the unique *Home Secretary* reply card permits readers to inquire about advertised products conveniently from their homes.

Distribution of *Petroleum Processing* is restricted to a management-built list. Only refinerymen designated by top executives of their companies as buying factors are eligible. Ninety per cent of the more than ten thousand copies are *home delivered* every month . . . never meet the fate of unread, routed office mail.

To reach refinerymen who make or influence decisions on processes and equipment, make your first choice *Petroleum Processing* . . . the youthful, aggressive, readable magazine that's delivered *at home* where a man has time to read!



THE BEST-READ REFINERY PUBLICATION
REACHING THE MOST REFINERY READERS

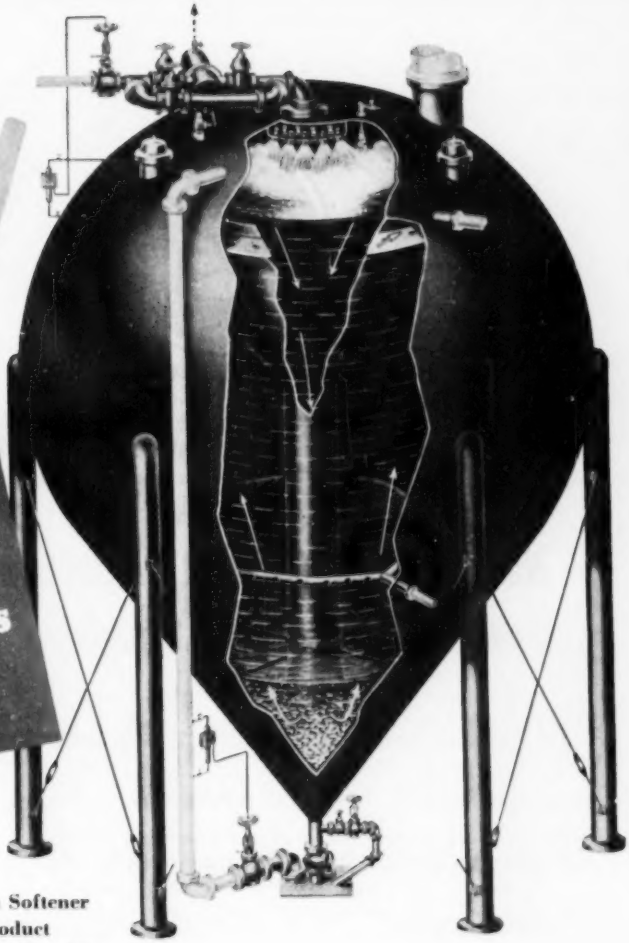
A Platt Petroleum Publication

Headquarters, 1213 W. Third St., Cleveland 13, Ohio . . . Offices in New York, Chicago, Philadelphia, Houston and Los Angeles

New!

GRAVER SPHERICONE

for Hot Process Softening . . .



An improved design for Hot Process Softener Sedimentation Tanks . . . another product made possible by Graver's unique combination of chemical engineering skill and tank fabrication experience. • The new Graver Sphericone has many functional and structural advantages over other designs of hot process softener sedimentation tanks:

1 ***Clearest softened water*** **. . . because the expanding settling zone provides maximum settling area and lowest rising rates. This assures minimum load on filters . . . saves operator's time and filter media replacement.**

2 ***Most efficient use of materials and space*** **. . . because of the exclusive Sphericone shape.**

3 ***Uniform stress distribution*** **. . . because of the virtual elimination of knuckle radii.**

GRAVER

The new Sphericone is made in Graver's own shops, together with all the other major component parts of the Graver Hot Process Softener. Write today for complete data.

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

216 WEST 14th STREET, NEW YORK 11, N. Y.

Cyanamid Vision

New Aerocat® Catalyst Production Plant Spearheads Cyanamid Expansion

Cyanamid has taken another step forward in its program of continued expansion to help the petroleum industry meet the demand for greater production of higher octane fuels. At Michigan City, Indiana, work has begun on a new plant to produce microspheroidal synthetic fluid cracking catalyst.

The increased capacity of this plant is representative of the long-range vision that has maintained Cyanamid leadership since the inception of the fluid catalytic cracking process. And such vision is still at work every day at Cyanamid...ready to help you solve your catalyst problems.

spurs catalyst progress

Cyanamid 1st in Development... American Cyanamid research pioneered many of the "first facts" about fluid catalysts. That pioneering still goes on. *Today* it brings you a variety of highest quality fluid cracking catalysts, headed by AEROCAT MS Grades of microspheroidal synthetic fluid cracking catalyst. *Tomorrow* it will work toward the development of catalysts with even greater catalytic cracking efficiency.

Vision, Experience, Facilities, Service... is the combination that enables Cyanamid to produce better chemicals for the petroleum industry: AEROLUBE® Additives for motor oils... AERO* Specialty Catalysts for chemical processes...Gasoline Dyes and Drilling Mud Chemicals. To learn more about these products and how they can help you...

send today for samples and literature.

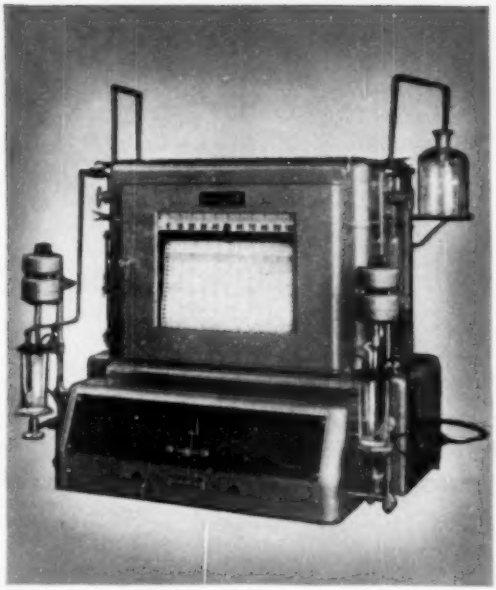
*Trade Mark

AMERICAN Cyanamid COMPANY

PETROLEUM CHEMICALS DEPARTMENT, DIV. C 11
30 Rockefeller Plaza, New York 20, N. Y.

Catalyst

When ∧ Performance counts...call on Cyanamid



PRECISION-Dow Dual Recordomatic Titrometer is one of the greatest *money-savers* in the Petroleum field. By saving time of technical personnel and keeping permanent chart record, it has reportedly "paid for itself in 3 months," "cut costs to scarcely ⅓rd," "daily runs 6 times former volume." Bulletin 7-640A

For New ECONOMY in Laboratory Apparatus

lower cost, more volume—

Specify *Precision to be Sure

PRECISION-THELCO Cabinet Line saves considerably on low original cost and long service. Quick, thorough controlled-temperature; larger interior; welded construction; safety catch; non-char asbestos door-seal; baked enamel finish; selection to suit every purpose. Ideal for the limited budget. Bulletin 7-376

To make your work easier, surer, more economical, replace or implement your present facilities with selections from some 3,000 Precision products. "Utility" items as well as highly specialized instruments are built beyond duty requirements.

Order from your Dealer **NOW!**

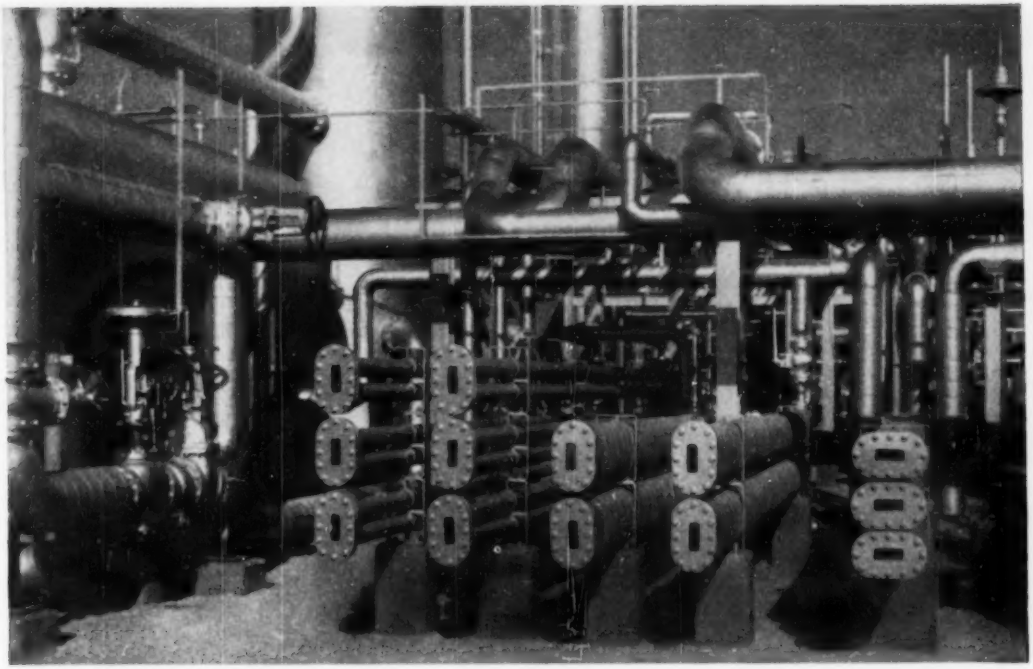
. . . or write us for details on above or your individual problem . . . today

Precision Scientific Company

3737 W. CORTLAND STREET—CHICAGO 47

* *FINEST Research and Production Control Apparatus*

NEW YORK • PHILADELPHIA • ST. LOUIS • HOUSTON • SAN FRANCISCO



use BROWN FINTUBE *Sectional Hairpin* HEAT EXCHANGERS *as*

- HEATERS
- COOLERS
- HEAT EXCHANGERS
- CONDENSERS
- GAS COOLERS
- REBOILERS
- FUEL OIL HEATERS
- LUBE OIL HEATERS AND COOLERS
- JACKET WATER COOLERS
- QUENCH OIL COOLERS
- COMPRESSOR INNER AND AFTER COOLERS

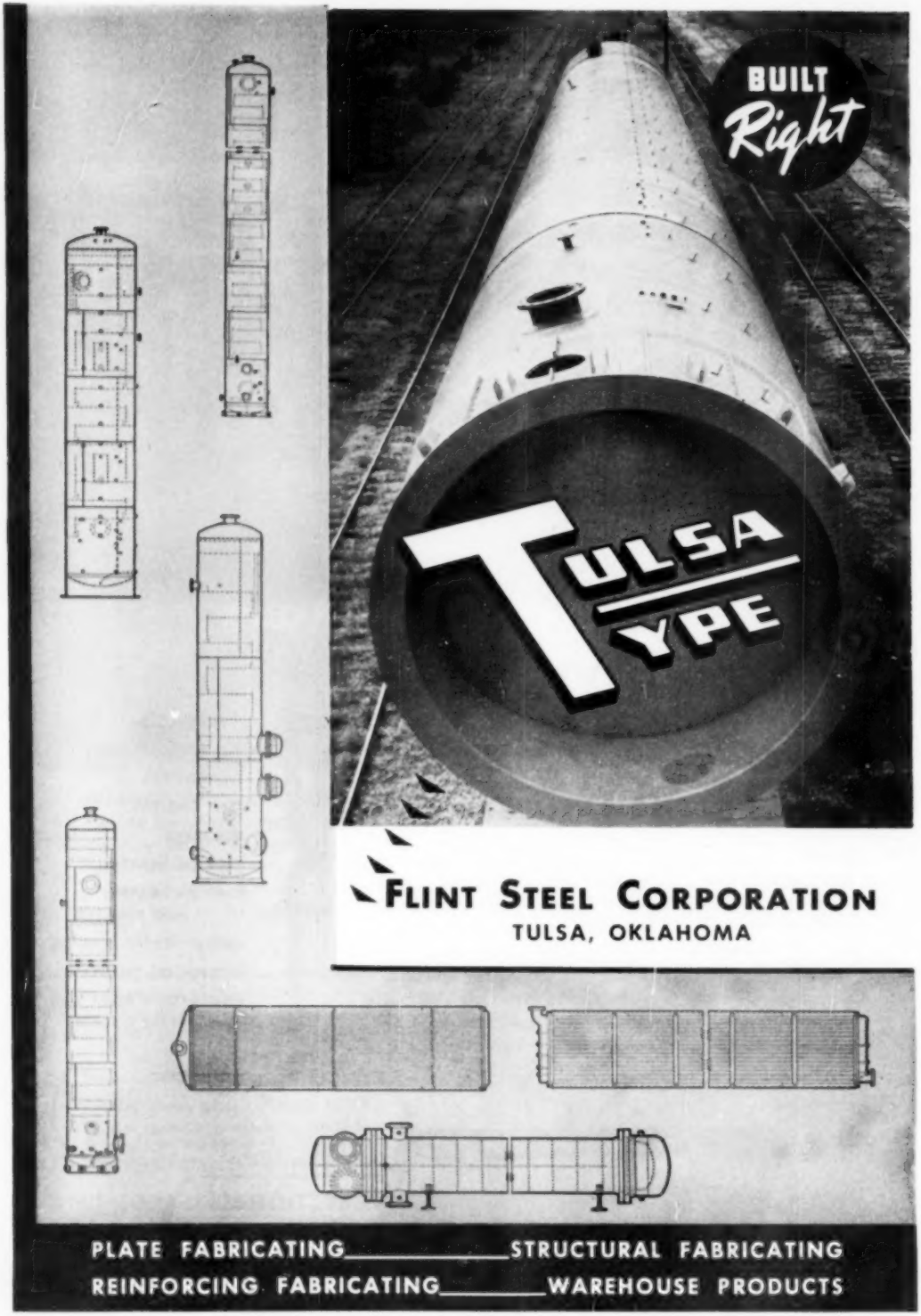
● These exchangers combine the repeatedly demonstrated advantages of Brown's exclusive integral "one-piece" fintubes that assure high heat transfer efficiency; and Brown's ring joint head end seal that is easily dissembled for cleaning, and reassembles tightly, preventing leakage. Furnished with fintubes of mild steel, stainless steel, monel, inconel, aluminum, admiralty or other non-ferrous metals to suit any requirement. Widely used — and highly endorsed by engineers, operators and maintenance men everywhere.

Write for Bulletin No. 481. It gives full details.

THE BROWN FINTUBE CO.
ELYRIA, OHIO

SECTIONAL HAIRPIN HEAT EXCHANGERS

[*To obtain more data on advertised products see page* 1236]

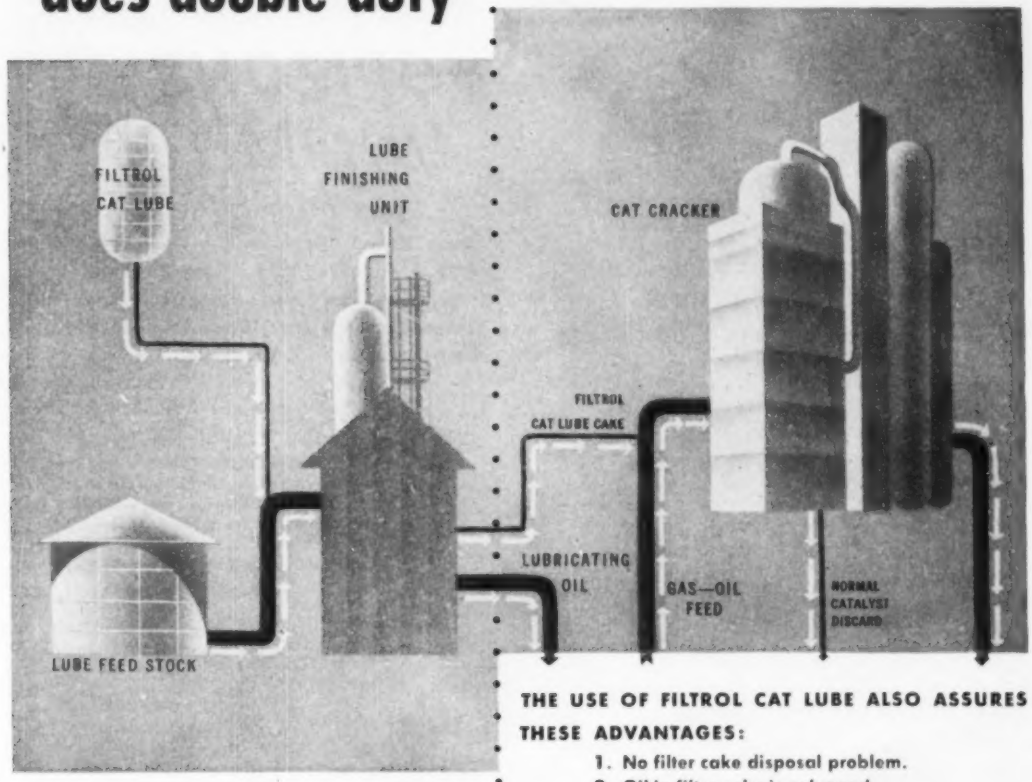


FLINT STEEL CORPORATION
TULSA, OKLAHOMA

PLATE FABRICATING STRUCTURAL FABRICATING
REINFORCING FABRICATING WAREHOUSE PRODUCTS

Filtrol* CAT LUBE does double duty

refines lubricating oil and then the spent adsorbent cake serves as a "fluid" cracking catalyst



THE USE OF FILTROL CAT LUBE ALSO ASSURES THESE ADVANTAGES:

1. **No filter cake disposal problem.**
2. **Oil in filter cake is salvaged.**
3. **Provides a constant supply of catalyst at practically no cost.**

An example of the successful use of Filtrol Cat Lube is the highly favorable experience of the Sinclair Refining Company which has been continuously using Filtrol Cat Lube for a year and a half with outstanding results in both lube processing and catalytic cracking.

Sinclair Refining Company was the first of many progressive refiners to take advantage of the economies made possible only through the use of "double duty" Filtrol Cat Lube.

Filtrol

ADSORBENTS • CATALYSTS • DESICCANTS

Write for information

FILTROL CORPORATION

General Offices: 727 W. 7th Street, Los Angeles 17, California
Plants: Vernon, California and Jackson, Mississippi

*T. M. REG. U.S. PAT. OFF.

This Cast Steel Pressure Seal Gate Valve is one of many Powell designs specifically engineered for Power Plants
HORIZONS UNLIMITED!
Today, Powell Valves meet every requirement of American Industry for long-life, dependable flow control equipment. And, as new demands arise, Powell will make the right valves to satisfy them.
Powell makes valves specifically adapted to YOUR industry. The Complete Powell Line includes Globe, Angle, Gate, Check, "Y", Non-return, Relief and Flush Bottom Tank Valves, in Bronze, Iron, Steel and the widest range of Corrosion-Resistant metals and alloys ever used in valves.
PATENTED
POWELL
1500
STEEL
POWELL
The WM. POWELL CO., 2525 Spring Grove Ave., P. O. Box 106, Station B, Cincinnati 22, Ohio

FIRST *NEW* DEVELOPMENT
IN SINGLE DECK ROOFS
IN 20 YEARS

GRAVER

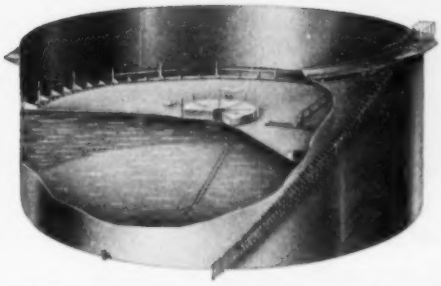
CENTER-WEIGHTED FLOATING ROOF TANKS

Patented design combines the stability and the vapor-saving, corrosion-resistant features of the double-deck floating roof with the more economical aspects of the conventional pan-type roof.

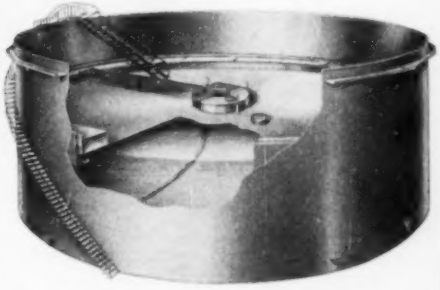
NEW FEATURES FOR IMPROVED PETROLEUM STORAGE

- Non-tilting, non-sinking; center of gravity below center of buoyancy.
- Fully effective single seal—no springs; nothing to get out of order.
- No air pockets under deck; full rim immersion—roof floats directly on product—no space for vapors to form.
- Requires *less steel* to build.
- Positive drainage at center due to increasing slope.
- Clear deck permits full accessibility, easy snow removal.
- Proved construction—tested in actual installations.

Send for New Book on Graver Center-Weighted Floating Roofs.



PAN-TYPE Center-Weighted Floating Roof . . . for southern climates where rain is the only weather problem.



PONTOON Center-Weighted Floating Roof . . . for northern climates involving snow, ice and rain.

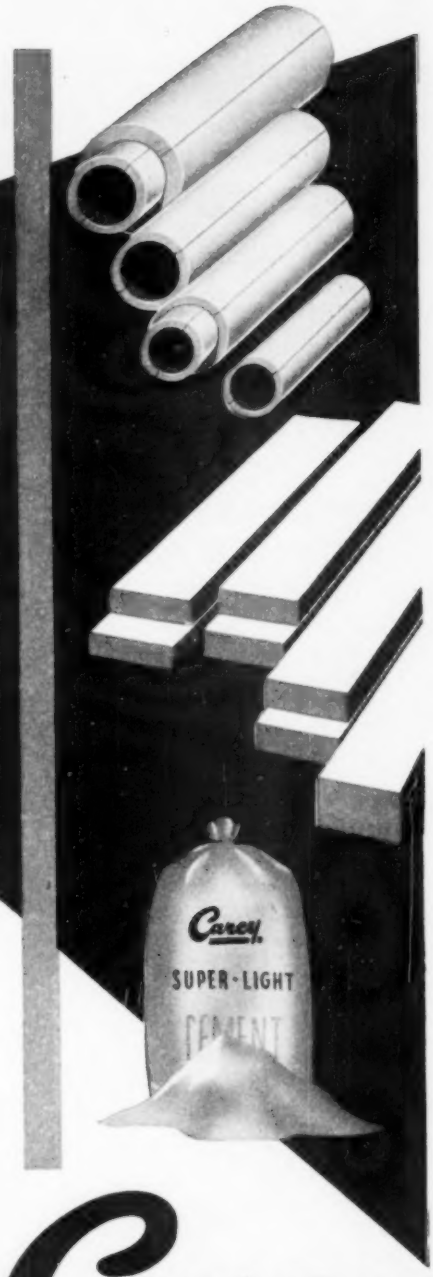
FABRICATED PLATE DIVISION

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA

NEW YORK • PHILADELPHIA • CHICAGO
DETROIT • CINCINNATI
CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.

Insulation sensati



1 More heat-savi

2 Extreme light weigh
freight and handling co

3 Available in new "nesting O
sized pipe coverings — precision-
and efficient insulating cement form

4 Large semi-cylindrical sections —
through 18" pipe size

Carey "Super-Light" is 85% Magnesia in a new, improved, better-than-ever form. Made under a new scientific precision-sized "self-set" method, it combines light weight, chemical purity, dimensional stability, high compressive strength and low thermal conductivity — factors that assure superior performance, extra years of dependable service.

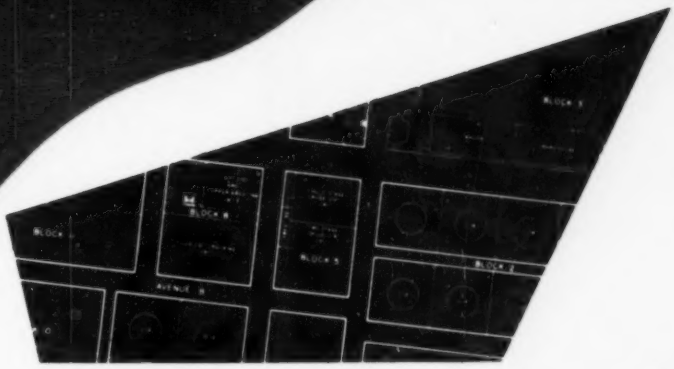
Carey "Super-Light" 85% Magnesia works wonders right from the start. Costs less to apply . . . performs miracles as a fuel-saver . . . increases plant efficiency.

Wherever you are, whatever your insulating needs, you're on your way to new economies, new highs in efficiency with Carey "Super-Light" 85% Magnesia on your job. For more detailed information about this latest **insulation sensation,** write or phone your nearest Carey office, or—

THE PHILIP CAREY MANUFACTURING COMPA
Cincinnati 15, Ohio
In Canada: The Philip Carey Company, Ltd.,
1557 MacKay Street, Montreal 25, P. Q.

Carey

refiners dream, too . .



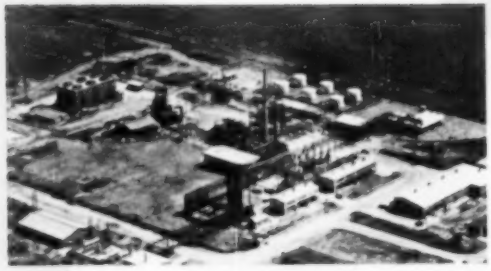
. . . of an ideal refinery layout . . . of a low-cost catalytic cracking unit . . . of new processes to keep pace with the ever-increasing Octane requirements . . . of a new crude unit, etc., . . . etc., . . . etc. . . .

Working with refiners throughout the world, for over 30 years, converting such ideal images—over 500 of them—into physical reality has been the job of the complete engineering and construction service—FOSTER WHEELER.

FOSTER WHEELER CORPORATION

165 BROADWAY, NEW YORK 6, NEW YORK

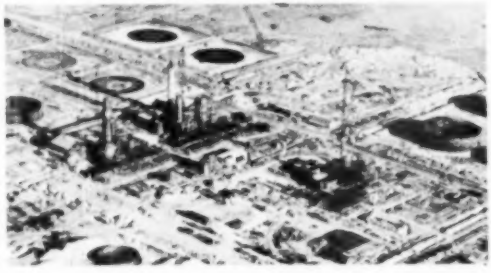
ONCE... <u>these</u> were but dreams



NOW . . . in Texas, a complete chemical plant is operating.

NOW...in Spain, a complete lube refinery is producing superior lubricants.

NOW... in England, construction moves along rapidly on the largest refinery in Europe.



Substantial proof that where there's a will— there's a way. We suggest the FOSTER WHEELER way.

FOSTER WHEELER CORPORATION

165 BROADWAY NEW YORK 6, NEW YORK

"Marshalling the forces of advertising to help solve national problems and to make democracy work better . . ."

DO YOU KNOW that the forces of advertising are engaged today in one of the world's greatest jobs of mass education . . . *in the public interest?*

Do you know that these forces for good have been released through the vision and unselfish cooperation of American business — advertisers, advertising agencies, media owners and others?

Hundreds of advertising agencies have volunteered their planning and creative time and facilities. Artists, cartoonists, photo-engravers, printers, typographers and others have contributed their services.

Media owners have donated millions of dollars in space and time. National and local advertisers have sponsored and paid for many millions of public service advertising messages.

As a result, the American people are being alerted as never before to the dangers which threaten from within and from without . . . the dangers of ignorance about our American economic system, intolerance, tuberculosis, school and teacher shortages, etc.

And, at the hub of this great public service effort is *your* organization . . . The Advertising Council.

Advertisers and Media Owners . . . Your Help is Needed!

Right now The Advertising Council has 14 programs in operation. The success of these programs depends on the public spirited and generous cooperation of advertisers and media owners. *Your* help, in the form of space or time donations, will mean a lot to us. And remember . . . *What helps America helps you!*

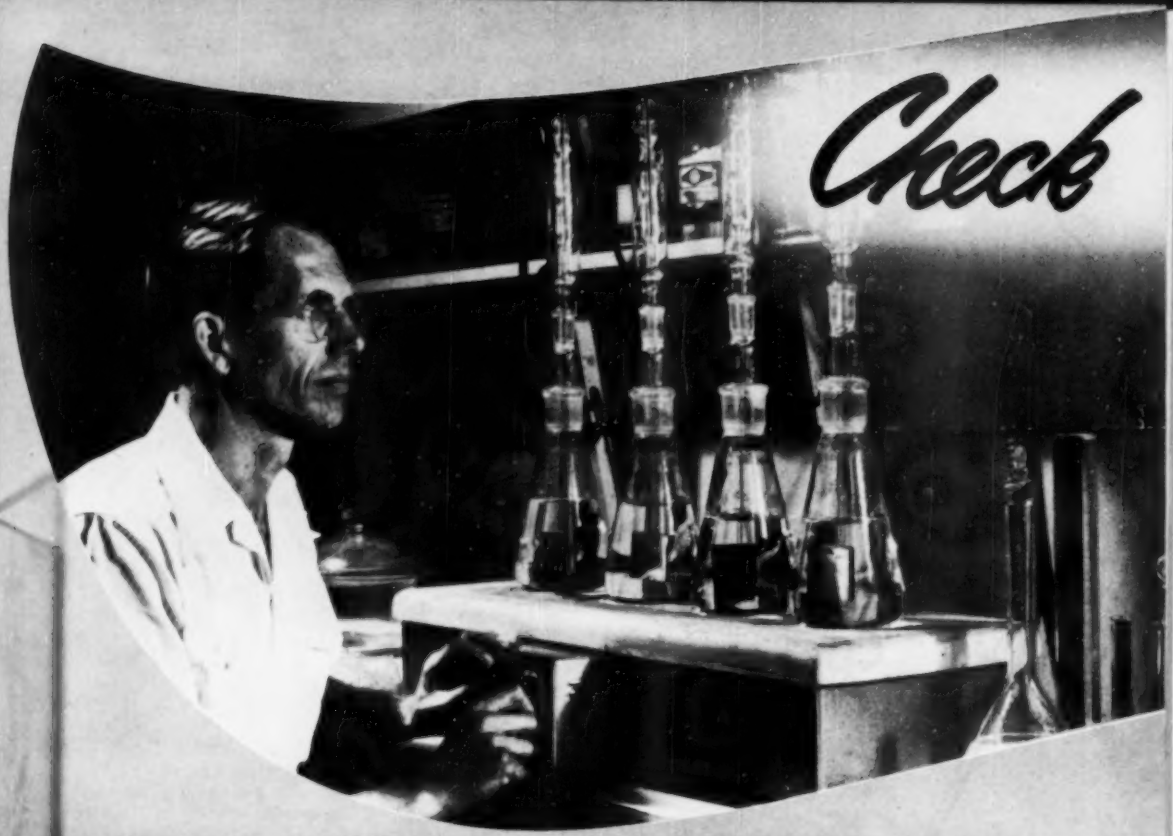
Yours for the Asking

Write for a copy of Booklet No. 15. It will give you pertinent information about The Advertising Council . . . how it started . . . what it is . . . what it does . . . Or ask for material on specific campaigns. Address: — The Advertising Council, 25 West 45th Street, New York 19, N. Y.

Published in the public interest by

PETROLEUM PROCESSING

*A NON-PROFIT ORGANIZATION FORMED TO UTILIZE ADVERTISING IN THE PUBLIC GOOD



Typical Applications in which Ampco Alloys have been used with Cost-Saving Success!

- Absorption columns
- Acetylators
- Acid chain
- Agitators
- Autoclaves
- Baskets
- Bearings
- Beater bars
- Bellows
- Bolts and nuts
- Brazing rod
- Brine coils
- Bubble caps and trays
- Calandrias
- Condenser shells
- Condenser tubes
- Condenser tube sheets
- Control valves
- Conveyors
- Coolers
- Crystallizers
- Dephlegmators
- Digesters
- Ejectors
- Evaporators
- Evaporator tubes
- Extractors
- Fabricated assemblies
- Filters and filter screens
- Filter presses
- Fittings — forged, cast
- Forgings
- Fractionating columns
- Hangers
- Heat exchangers
- Heater coils
- Hooks
- Injectors
- Instrument cases and elements
- Kettles
- Line hardware
- Meter cases
- Mixers
- Pans, evaporator
- Perforated plate
- Pickling baskets
- Pipe and fittings
- Plug cocks
- Pressure vessels
- Pumps
- Reboilers
- Retorts
- Rivets
- Safety tools
- Screens
- Screws, conveyor
- Sludge burners
- Springs
- Stills
- Studs
- Sucker rod
- Tanks
- Tools, safety
- Towers
- Trays, fractionating
- Tubes and tubing
- Vats
- Valves
- Welding rod
- Well tubing
- Wire
- Woven wire cloth

Chemical Agents and the Applicability of AMPCO Alloys

Acetate Solvents (Pure)	E
Crude	G
Acetic Acid	
Crude	E
Vapors	E
Acetic Anhydride	G
Acetone	E
Acetylene	NR
Alcohols	E
Aluminum Fluoride	G
Aluminum Sulfate	G
Aluminum Hydroxide	E
Ammonia Gas	
Dry	G
Wet	NR
Ammonium Chloride	NR
Ammonium Hydroxide	NR
Ammonium Nitrate	F
Ammonium Phosphate	F
Ammonium Sulfate	F
Amyl Chloride	E
Asphalt	E
Barium Chloride	G
Beer	E
Beet Sugar Liquors	E
Benzene or Benzol	E
Borax	E
Boric Acid	E
Brine	E
Butane, Butylene	E
Butadiene	E
Butyric Acid	E
Calcium Bisulfite	G
Calcium Hydroxide	G
Calcium Hypochlorite	F
Cane Sugar Liquors	E
Carbolic Acid	E
Carbon Dioxide	
Dry	E
Wet	G
Carbon Disulfide	F
Carbon Tetrachloride	E
Caustic Soda	E
Chlorine	
Dry	G
Wet	NR
Chloroform	E
Chromic Acid	NR
Citric Acid	E
Copper Sulfate	NR
Crude Oils — Sour	G
Esters	E
Ethers	E
Ethylene Glycol	E
Ethyl Sulfate	E
Ferric Chloride	NR
Ferric Sulfate	NR
Formaldehyde	E
Formic Acid	E
Freon	E
Furfural	E
Gasoline	E
Gelatine	E
Glucose	E
Glycerine	E
Hydrocarbon Gases	E
Hydrochloric Acid	
to 5%	G
to 10%	F
(see Muriatic)	
Hydrocyanic Acid	NR
Hydrofluoric Acid	G
Hydrogen Fluoride (Dry)	E
Hydrogen	E
Hydrogen Peroxide	F
Hydrogen Sulfide	
Wet	NR
Dry	F
Lacquers and Lacquer Solvents	E
Lactic Acid	E
Magnesium Chloride	G
Magnesium Hydroxide	E
Magnesium Sulfate	E
Malt Beverages	E
Mercuric Chloride	NR
Mine Water (Sulfate)	E
Molasses	E
Monochlorobenzene	E
Muriatic — Cold, Commercial	G
Naptha	E
Natural Gas	E
Nickel Chloride	F
Nickel Sulfate	G
Nitric Acid	NR
Nitrogen (Dry)	E
Oleic Acid	E
Oxygen	E
Paint Vehicles (Except Soya-Oil)	G
Palmitic Acid	E
Petroleum Oils	
Sour	G
Refined	G
Phenol	E
Phosphoric Acid	E
Pickling Acid (except Nitric Chromic)	E
Potassium Chloride	E
Potassium Cyanide	NR
Potassium Hydroxide	F
Potassium Sulfate	E
Potash Crudes	E
Propane	E
Shellac	E
Soaps	E
Soda Ash (Sodium Carbonate)	G
Sodium Bicarbonate	E
Sodium Bisulfate	E
Sodium Carbonate	E
Sodium Chloride	E
Sodium Cyanide	NR
Sodium Hydroxide	E
Sodium Nitrate	G
Sodium Perborate	E
Sodium Peroxide	F
Sodium Phosphate	
Alkaline	E
Neutral	E
Acid	G
Sodium Silicate	E
Sodium Sulfate (Soda Cake)	E
Sodium Sulfide	NR
Sulfur	F
Sulfur Chloride	NR
Sulfur Dioxide	
Dry	G
Wet	G
Sulfuric Acid	
5%)	E
10%)	E
25%) Up to Boiling	E
35%)	E
50%)	E
Sulfuric Acid Sludge	E
Sulfurous Acid	G
Tannic Acid	G
Tartaric Acid	E
Toluene or Toluol	E
Tri Chlorethylene	E
Tri Sodium Phosphate	E
Turpentine	E
Varnish	E
Vegetable Oils	E
Water	
Fresh	E
Salt (includes Polluted Harbor)	E
Xylene	E
Zinc Chloride	G
Zinc Sulfate	E

These ratings may usually be interpreted as follows:

E — Excellent
IPY Penetration
< 0.008"

G — Good
IPY Penetration
< 0.016"

F — Fair
IPY Penetration
< 0.050"

NR — Not Recommended
IPY Penetration
Over 0.050"

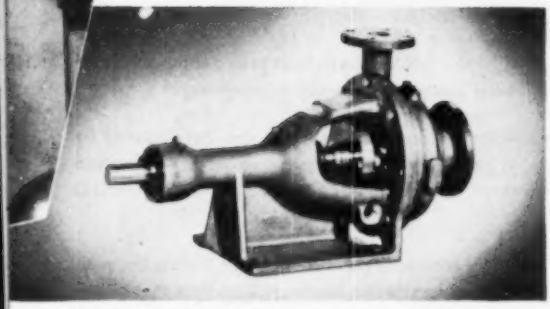
In using this data, it should be understood that these are results of specific tests and are indicative of those conditions under which the tests were run, and are a basis for recommendation, but not for guarantee.

AMPCO

Your Corrosion Problems

...use Ampco Alloys

...these unique properties have proved to be the best answer to many process equipment problems



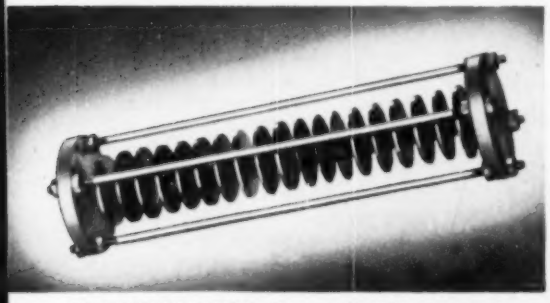
Ampco Centrifugal Pumps — Here — for the first time in pump manufacturing history — is a "production-built" and "production-priced" pump to handle acids, alkalies, and other corrosive agents hitherto requiring specially built pumps. The Ampco single-stage, single-suction centrifugal pump offers long life, high efficiency and low maintenance costs through the combination of correct design and properly selected materials.

1. High resistance to corrosion
2. High tensile strength
3. High physicals at extreme temperatures
4. High strength to weight ratio
5. High impact and fatigue values
6. High wear-resistance — to erosion — corrosion — cavitation, etc.
7. High compressive strength
8. High modulus of elasticity

Designers and plant engineers in the process industries are turning to Ampco Alloys more and more frequently — because of the outstanding savings offered by their long-lasting qualities.

Costs are reduced in three ways: 1. Minimum down time, 2. Minimum product loss from parts failure, and 3. Minimum maintenance and replacement expense.

Study the list of time-proven applications and the Ampco applicability chart and apply this data to your own needs. Plan your own economies now by specifying Ampco Bronze Alloys for corrosive and erosive media handling. Write today for recommendations and complete information.



CORROSION TESTING—Types of Test Specimens — A complete stock of test specimens of a wide variety of materials is kept ready for mounting on racks. Several forms of racks are available for tests in atmospheric locations, pipe lines, tanks or other pressure vessels. When requesting test specimens please outline conditions under which test is to be conducted so that we may supply the most suitable form.

★ ★ ★

Ampco aluminum bronzes are available in a number of grades to meet your exact requirements in any form you need: rolled sheet or plate, sand or centrifugal castings, forgings or extrusions . . . pipe and fittings. Also, Ampco's arc-welding electrodes, corrosion-resistant centrifugal pumps and plug valves.

AMPCO

Ampco Metal, Inc.
Milwaukee 46, Wisconsin
West Coast Plant *Burbank, California*

Free . . .
Process Industries Bulletin — 16 pages of money-saving information.

Ampco Metal, Inc., Dept. PP-11, Milwaukee 46, Wis.

Send me your free bulletin, giving full information on the application of Ampco Alloys in the Process Industries.

Name ..... Title .....

Company .....

Company Address .....

City ..... ( ) State .....

WHERE LESS YIELDS MORE

Gradiation LESS TIME . . . LESS SPACE MORE PETROLEUM PROCESSED

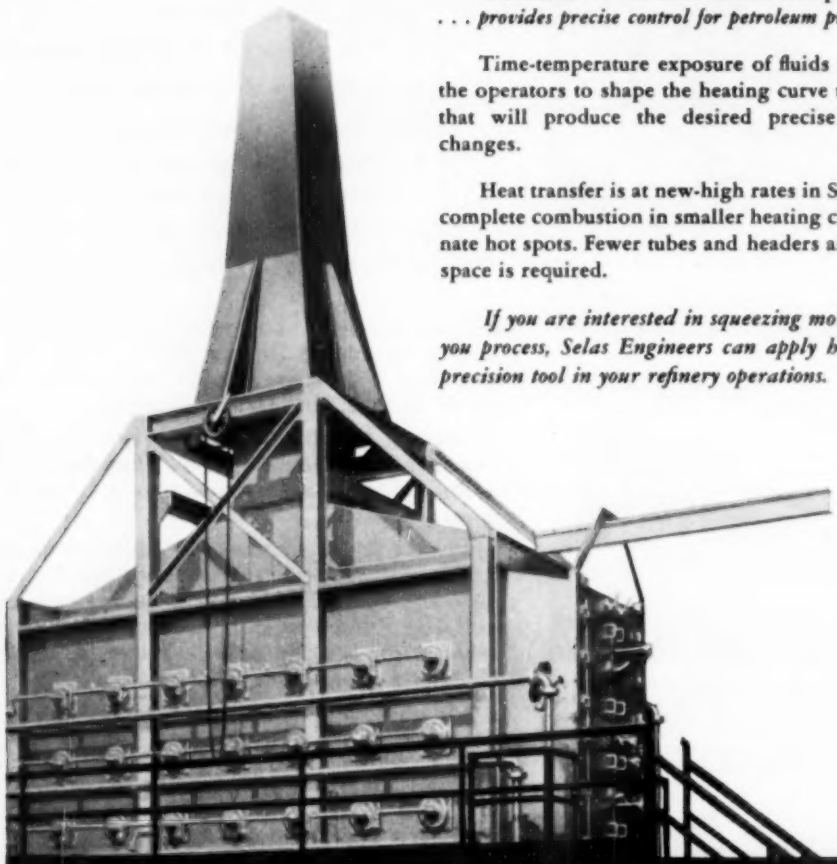
More petroleum is heat-processed in less time, with higher yield and lower costs, in new Selas tubestills now operating in the Petroleum Industry. Heat-processing techniques are advancing—sharply—in these new stills.

Gradiation . . . the Selas radiant heat processing principle . . . *provides precise control for petroleum processing.*

Time-temperature exposure of fluids can be adjusted by the operators to shape the heating curve to any specification that will produce the desired precise physical-chemical changes.

Heat transfer is at new-high rates in Selas tubestills, with complete combustion in smaller heating chambers that eliminate hot spots. Fewer tubes and headers are required . . . less space is required.

If you are interested in squeezing more out of every drop you process, Selas Engineers can apply heat processing as a precision tool in your refinery operations.



SELAS CORPORATION OF AMERICA
PHILADELPHIA 34, PENNSYLVANIA

Two or three 12 x 36 x 20 duplex horizontal steam driven opposed, single-stage Worthington Vacuum Pumps in the Lake Charles, La., plant of the Cit-Con Oil Corporation. Other Worthington units at this plant include four additional vacuum pumps and three centrifugal propane refrigeration units, as well as 14 double pipe scraped surface type exchangers and 12 chillers.

The Worthington Vacuum Pumps shown here are used in conjunction with rotary filters in the dewaxing of petroleum lubricating oil stocks.

OVER $500,000 WORTH OF WORTHINGTON EQUIPMENT IN LAKE CHARLES PLANT

In this, as in so many other vital refining processes, the outstanding performance of Worthington Vacuum Pumps is a matter of common knowledge among refinery engineers. For, these famous units are highly specialized machines — the results of continued co-operation with the petroleum industry and long research into its special needs.

With the ruggedness that means longer service life, they're simplified for quick accessibility and precision-built for close clearance, embodying such advanced features as Worthington Feather* Valves — lightest, tightest, "easiest breathers" ever made.

FOR YOUR APPLICATION

Worthington Horizontal Dry Vacuum Pumps are available in the widest range of types, sizes and drives — each conservatively rated to assure ample reserve power, each designed to produce steady high vacuum at lowest possible operating cost. Bulletin L-710-BIB contains a full listing, together with further facts proving *there's more worth in Worthington.* Write to *Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, N. Y.*

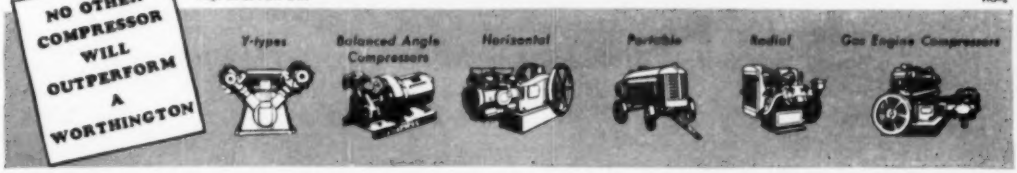
SEE OUR CATALOG IN THE COMPOSITE CATALOG

WORTHINGTON

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON

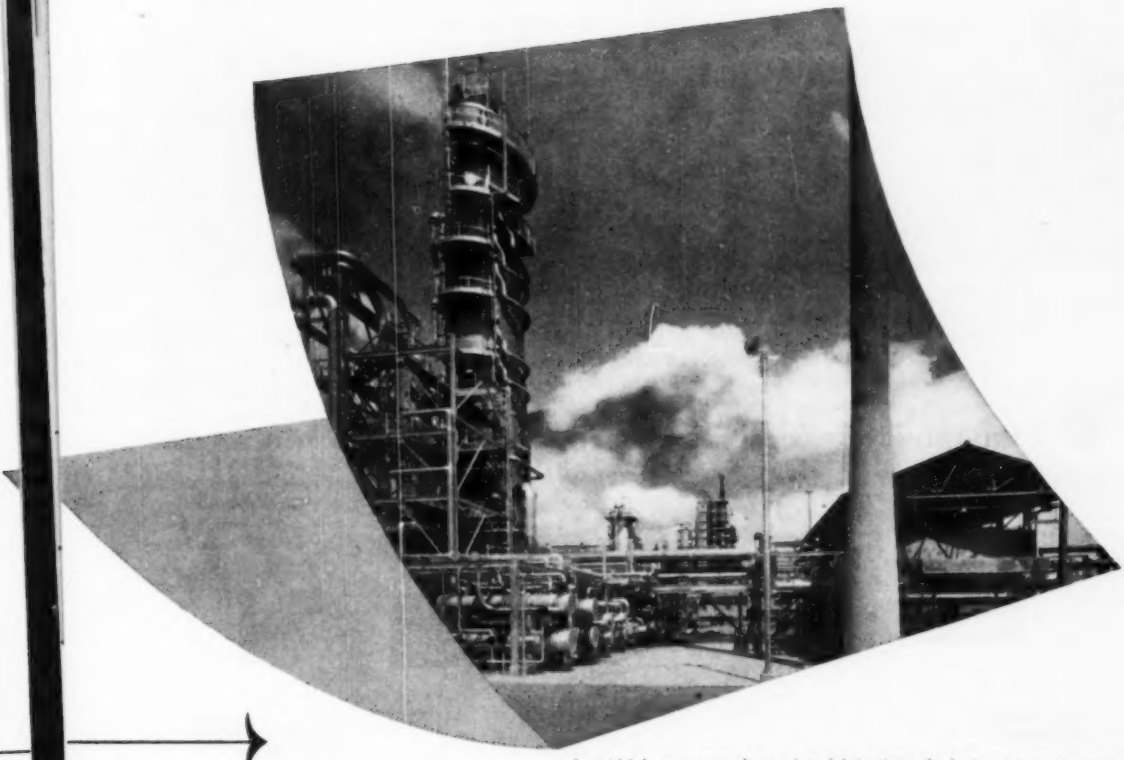
*Reg. U. S. Pat. Off.

KO-2



NEW LUBE OIL PLANT FOR SOHIO

designed and built by LUMMUS



In mid-July a new and complete lubricating oil plant went on stream at SOHIO's large Lima refinery. Lummus designed and built four of the five processing units which will produce approximately 1800 barrels per day of high grade lubricating oils.

Lummus applied new and improved techniques in the design of SOHIO's lube-oil plant. A new fluidized method of clay handling is employed in the contact units. A hot oil-belt system provides all the heat required for the FURFURAL, MEK, and CLAY-CONTACT Units. A single console instrument panel is used to control the operation of the FURFURAL and MEK Units.

The Lima plant reflects the leading role Lummus has played in the building of outstanding lube-oil refineries. Lummus has designed and constructed over 115 lubricating oil processing units. To a study of your individual problems, whether solvent refining, the modernization and expansion of existing units, or new projects, Lummus can add the experience gained through years of designing and building petroleum, petroleum chemical and chemical plants.

PETROLEUM HORIZONS, the new 80-page book on Lummus processes and plants, features a step-by-step description and flow sheets for 31 refinery processes. Your copy available on request.

THE LUMMUS COMPANY

designing engineers and constructors for the petroleum and chemical industries

385 Madison Avenue • New York 17, N. Y.

CHICAGO • HOUSTON • LONDON • CARACAS • PARIS

For a bigger choice of better piping
Choose from the broad CRANE line

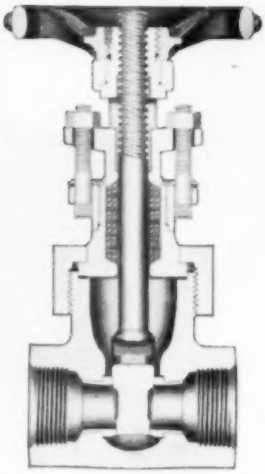
LOW IN PRICE . . . HIGH IN PERFORMANCE

Need small steel valves you can count on for quality performance . . . yet are low in initial and maintenance costs? Then specify these Crane 600-Pound Union Bonnet Small Steel Gates.

They're strong—body, bonnet, and yoke are high quality Crane carbon steel. And they're easy to operate. Wedge disc, closely guided throughout travel, does not get out of line or jam in body. Non-rigid disc-stem connection prevents stem distortion and binding of parts.

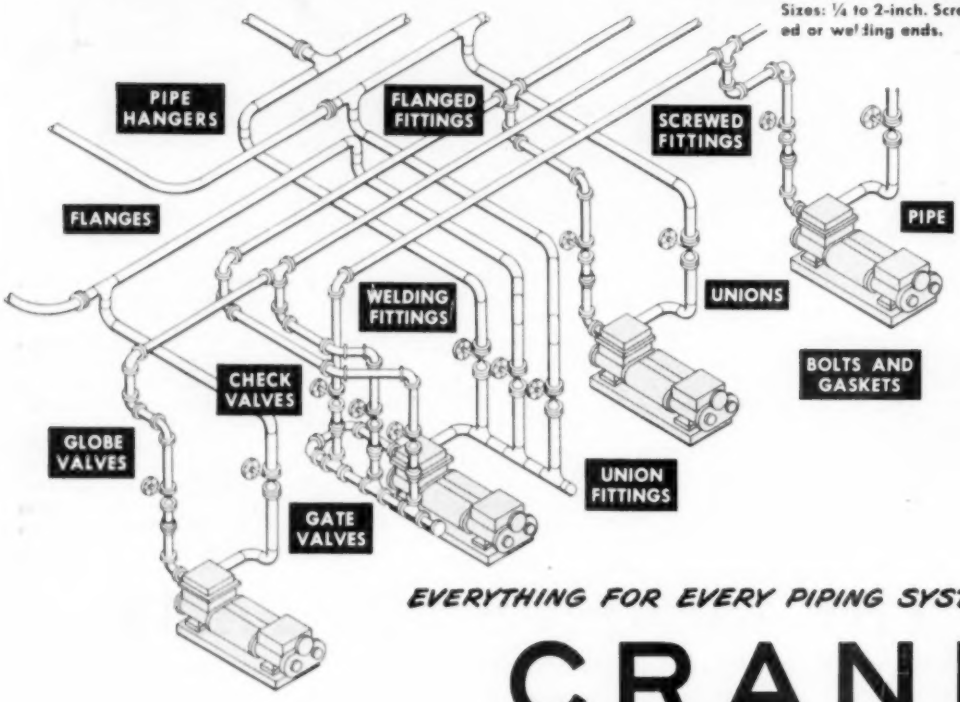
Want maximum protection against leakage? Then note these features: Stuffing box—deep and filled with high-quality packing. Bonnet joint—male and female design, fitted with soft iron gasket. Body seat rings—securely rolled-in to prevent loosening in service. See your No. 49 Crane Catalog, or send for Circular AD-1741.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



No. 3602X, 600-Pound Small Steel Gate for oil or oil vapor up to 1000° F. Exalloy to Exalloy seating. Sizes: ¼ to 2-inch. Screwed or welding ends.

DISTILLATION PUMP ROOM PIPING, FOR EXAMPLE, CAN BE COMPLETELY EQUIPPED ON ONE ORDER TO CRANE



EVERYTHING FOR EVERY PIPING SYSTEM

CRANE

VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

IT DOES HAPPEN TODAY! The Wonsan oil refinery in Korea, one of the largest in the Far East, lies in ruins after repeated aerial attacks by UN planes

Organize Plant Protection NOW

Suggestions for Setting up Defense Measures Against Sabotage, Espionage and Bomb Attack in Refineries and Other Oil Company Facilities, with Emphasis on Immediate Alerting of Employees to These Dangers

By FRANK V. MARTINEK
Asst. Vice President, Standard Oil Co. (Ind.)
Chairman, Plant Protection Committee,
Chicago Civil Defense Organization

SINCE wars today are not fought upon the battlefields alone, the petroleum industry's refineries and other facilities might be among the prime and initial targets of an enemy. If there are any oil company men who have the mistaken idea "it can't happen here", let them be reminded that increased speed of transport and power of destruction have made every spot in this world vulnerable to attack and possible annihilation.

With war already thrust upon us, subversive agents, spies, and saboteurs are even now at work in our country. They are preparing to take advantage of our unpreparedness by two forms of sabotage; mechanical, to destroy the tools with which we work, and psychological, to destroy our morale by vicious propaganda, creating fear and hysteria.

As for the atom bomb and bacteriological warfare, we're like babes in the woods when discussing these weapons, because of lack of experience and training. However, if every refinery, with its facilities, is prepared in advance with fire control equipment, rescue squads, training in how to co-operate with police, fire departments, civil defense agencies and others as a part of their plant protection and security plan, it will be as well prepared as anyone can be to defend himself if full war comes.

Let me caution you that we have thousands of atom bombs wearing pants, roaming promiscuously up and down the byways and highways of our country. They are terrorists specially trained in the university of terrorism, sabotage and espionage. By flipping a valve, pressing a buzzer, or setting off an incendiary bomb, they can do much destruction to stop the flow of material on a supply line. They at least can touch the vital spot of a plant directly and not by guess work.

Our job specifically is to protect life and property against successful enemy attacks in all forms on our refineries, terminals, pipelines and other oil industry properties, and to restore those facilities to normal or near normal operations as speedily and efficiently as possible if they are attacked.

While a general outline can be presented of what is necessary for plant protection and security under modern techniques of warfare, each plant must rest upon its own requirements in setting up its own program. The primary responsibility rests upon plant owners and operators to organize their own protection and security agencies, and to be prepared on the basis of what experience is available to cope with every problem that may arise.

It is recommended that each refinery or other facility, at the top, organize a committee on plant protection and security. The plant protection officer selected to head the program should be an executive, preferably one experienced in the field of law enforcement, safety, protection, and security. Since he will supervise and direct all plant and facility co-ordination, he must have the respect and cooperation of plant man-

agement and employes in the performance of his duties.

The work of the plant protection committee in drawing up its program should be divided into two sections:

1. It should take immediate steps for the protection and security of all facilities and personnel and it should direct the coordination of all plans for action into a pattern for civil defense.

2. It should draw up a definite plan to become effective only upon the declaration of war, to cover special measures and techniques necessary to carry out defense against the destructive forces of an atom bomb, and bacterio'ogical warfare, sabotage, espionage, and subversive activities.

The p'ant protection officer and members of his staff should plan to maintain liaison and co-operative contact with the Army, Air Force, Naval and A.E.C. intelligence units, F.B.I., and with the municipal, state and national defense agencies and any other enforcement units in the area.

The p'ant protection officer should be an integral part of the local defense organization. All units of the refinery or other facilities should be put on immediate alert for the protection and security of facilities and manpower. Each department head shou'd be held accountable for the protection and security of his respective plant and facility.

Several features from a broad outline of plant protection and security are given below to guide refinery managers and operators in developing their own p'ant security programs to meet specific existing conditions.

Plant Control Facilities

A Plant Control Center should be organized under the direct supervision of the Plant Protection and Security Officer. It must be located in a protected area and, if possible, it should be operated separately and apart from all other plant activities. It must serve as the nerve center for all plant protection and security activities.

Full co-ordination of all plant facilities and departments under the Plant Protection and Security Officer is essential to the success of the security program, hence the selection of co-ordinators for each processing unit and department should be made carefully.

Volunteer groups of workers should be organized and trained to function in an emergency. Training programs for the vo'unteer workers should be established to fit them to serve as auxiliary firemen, fire watchers, air raid wardens, auxiliary police, first aid teams, rescue teams and in radiological monitoring.

The vo'unteer groups should remain on the scene during an attack and prevent loss of managerial supervision of personnel. They will direct rescue work, evacuation of injured, take necessary measures to minimize dangers from fire, and to prevent looting and direct the work of restoring damaged and disrupted facilities.

Clearing House

The Plant Protection and Security Officer should establish in the control center a clearing house for gathering, classifying and collating information from all sources within and outside his company.

The clearing house should at all times exercise discretion in evaluating the information it collects before it is sent to government agencies for further investigation. Gossip and unfounded rumors must not be given in reports to outside agencies. They may injure innocent people and unduly burden units charged with investigating the reports.

The clearing house should contain centralized files of all information covering defense plans, plant protection and security measures, sabotage, espionage and subversive activities.

Facts and figures, plans and recommendations, and other important information about the protection program should be disseminated in bulletin form and through company magazines and trade publications, so that all concerned will have up-to-date news about the refinery's work in this direction.

Sabotage Protection

Saboteurs carry on their nefarious work in two ways, on foreign and domestic soil, by both mechanical and psychological means. It cannot be too strongly emphasized that saboteurs are continually at work, carrying on their undercover operations. Some of their work is unorganized, but most of it is highly organized and directed. Their targets in mechanical sabotage are vital material resources, communications facilities, transportation facilities, industrial facilities, food and drinking water through contamination and pollution, plants manufacturing war material, and MANPOWER AND WOMANPOWER.

Saboteurs achieve their psychological aims, among other methods, by undermining morale and creating dissension, in order to weaken or destroy the spirit of those responsible for the free flow of supplies to military units in time of war or national emergency.

Espionage

Espionage is defined as efforts at (a) unlawful obtaining or transmitting of defense or war information; (b) unlawful disclosure of information affecting national defense, (c) photographing or sketching defense installations or equipment for any purpose except authorized use.

The protection of all classified, secret, confidential or restricted information is one of the vitally important duties of the oil company refinery or other facilities security program. Keys and safe combinations must be issued to only a limited number of trusted employes. Waste paper must be disposed of by burning or shredding. Guards, watchmen, patrolmen, janitors and charwomen should be examined and checked closely at all times. Reports of any actions suspected as being espionage should be given promptly to a department head or supervisor and, through him, to the Plant Protection Officer, if advisable. They may then be transmitted through the proper channels to governmental agencies.

Espionage is carried on through the infiltration of spies into plants. Members of the managerial staffs of refineries should be alerted to the ways in which spies conduct their operations such as (a) obtaining admission as privileged visitors or inspectors, through impersonations and through other fraudulent means; (b) purchasing information from employes; (c) stealing or purchasing plans, specifications, or other confidential documents; (d) making copies of documents; (e) photographing documents or reproductions of documents.

Employees should be told frankly that they may be inconvenienced in carrying on their work because of the rules and regulations necessary to adopt to trap or thwart spies, saboteurs, and subversive agents. They should also be kept informed about special precautions that must be observed and advised that they keep vigilant.

Plant operators and all workers should be told the importance of reporting to their immediate superior any persons whose actions lead to suspicions of subversive work of any kind. They should also report the finding or observing of any condition or practice that may result in damage to property or injury to employees or others.

Employees should not try to evaluate such information themselves. They should be reminded again and again that what appears to be of minor importance is important enough to report, because it may be a link in a chain of evidence that will help break a spy ring. Employees should be told not to play detective. Their amateur efforts may spoil a case for the authorities. They should be admonished to be patient, even though the governmental or other agencies seem to be doing nothing about the information given them. It is often necessary for suspected persons to be kept under

close surveillance for months until every contact and movement of those suspected is learned.

It is also important to caution workers not to spread gossip and rumors because they injure the innocent and burden the FBI with needless work in so doing. They should not be suspicious of persons with foreign sounding names. Minority persecution is a breeding ground for Fifth Columnists.

Every employee should be impressed with the fact that, in reporting any act that he suspects of being against the defense program or war effort, he not only protects his own job, but he also takes steps that may protect his own life.

Employee Identification

Non - tamperable identification badges and cards should be adopted for the refinery or other plant facility, if not already in use. Guards, patrolmen and watchmen should be trained in the known effective methods of checking badges carefully so that only persons responsible for the free flow of the production line may be permitted to enter and leave the plant.

All gates should be tightened, rigidly, and entrances should be vigilantly guarded, so that unauthorized persons will be kept out. The outer perimeter of the plant property should be periodically checked by a prowl car. There must be a rigid check-in and check-out system for employees. All packages, bundles and lunch boxes should be examined carefully.

Movement of employees must be restricted to their own particular work areas.

Outside contractors and sub-contractors should be held responsible for investigation of all their employees that have access to the refinery. Special identification buttons or badges with special designations should be adopted, to differentiate company employees from outside contractors and sub - contractors' employees. Such buttons or badges should also designate the area to which the men are assigned.

A special gate should be set aside for checking in and out of outside employees, their tools, equipment, bundles, packages, and lunch boxes.

The plant protection staff should take all steps necessary to emphasize on outside contractors and subcontractors that it is their responsibility to check their material and equipment, to vouch for the loyalty of their employees and to identify them as they enter the refinery or other facility.

Personnel Problems

Employees and applicants for employment should be fingerprinted, without exception. Arrangements should be made with local enforcement officials to train employees in carrying out this responsibility.

All employees, including those of long years of service as well as those newly employed, should be carefully and discreetly investigated concerning their loyalty and dependability. Employees must be selected with the utmost care and screening.

The problem of aliens must be handled with extreme care by the Plant Protection and Security Officers through the Industrial Relations programs of the company concerned. Aliens visiting any refinery or other manufacturing plant should be required to obtain special clearances, and at all times be escorted while in the plant.

All visitors, salesmen, and employees from other departments should be registered. The log should show the date, time in, name, citizenship, company represented, person to see, purpose of visit, time out.

Protection of Plant Area

All taking of photographs within the plant should be prohibited, unless the practice is authorized by management as essential. The subject of airplane flights over vital plant facilities should be discussed with the proper government authorities, to prevent possible espionage and sabotage. All planes crossing restricted areas should be identified, if possible.

In a well-fenced, well-lighted, well-screened and well floodlighted plant, the spy and saboteur are thwarted, at least in part, before they begin their work.

Special means of protection should be given to areas that are specially restricted, either because of the nature of processing operations or other work carried on there, or because special tools and equipment are kept there. Included in the protection for such areas should be shipping platforms, parking areas, emergency exits and entrances.

Communication systems within the plant, power houses, water intakes, underground water, electrical and gas facilities must be protected at all times against possible sabotage.

Trucks moving in and out of refineries should be examined carefully for explosive and incendiary bombs. Truck passes should be registered and time stamped when truck enters and leaves the plant.

All packages on persons seeking admission should be examined carefully before admission to the plant is granted.

Safety Measures

Every possible effort should be made to prevent fires, protect property, and eliminate possible accidents, all of which may be the work of saboteurs.

Fire prevention and protection, such as good housekeeping, physical barriers, and so on are essential. Care should be exercised to eliminate all fire hazards associated with electrical equipment and maintenance; oil and gas fired equipment; portable cutting and welding equipment; automatic sprinkler systems. Fire prevention and accident prevention work should be emphasized. Fires and accidents, even though not the result of sabotage, are costly to the plant production schedule.

Plant Protection Is "Down His Line"

During a long colorful career, Frank V. Martinek has battled spies and criminals as Intelligence officer of the Asiatic Fleet in World War I, as a special agent of the Department of Justice from 1921 to 1925, and as chairman of the oil industry's Central Gasoline Tax Evasion Committee since 1931.

Assistant vice-president of the Standard Oil Co. (Indiana) since 1928, he knows intimately the personnel and many of the operating problems of the oil companies. During World War II he was vice chairman of the Great Lakes Plant Protection Committee of the petroleum industry. Not a gallon of product was lost during the war at any petroleum facility in this area.

Mr. Martinek is more widely known to the general public as creator and author of the newspaper adventure strip "Don Winslow of the Navy," which he started writing in 1934. He is the author of the book, "Know Your Man," on the selection and placement of employees. He has made more than 50 talks so far this year in the Midwest on the topic "Freedom Isn't Free."

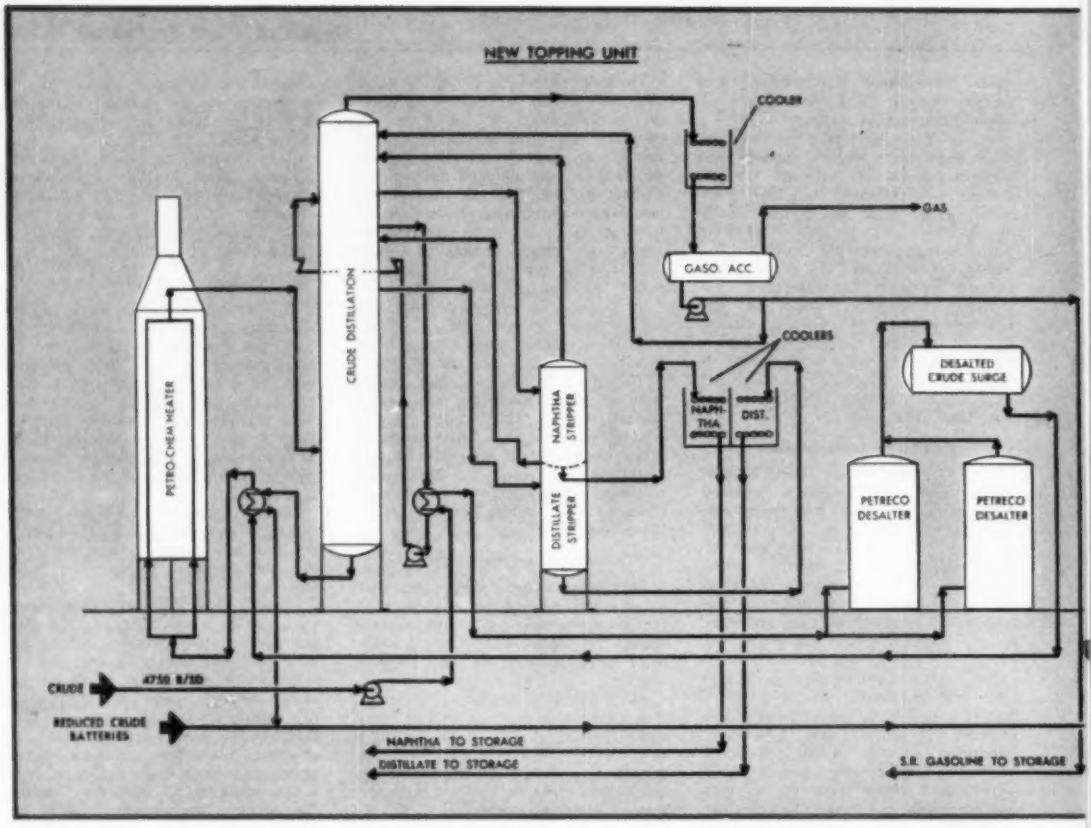


FIG. 1—Process flow diagram for modernized Deep Rock refinery at Cushing, Okla., showing crude topping, catalytic cracking feed preparation and schematic of Fluid unit protection

New Crude Topper, Cracker Expand Independent Refiner's Facilities

By D. P. THORNTON, Jr.
Southwestern Editor

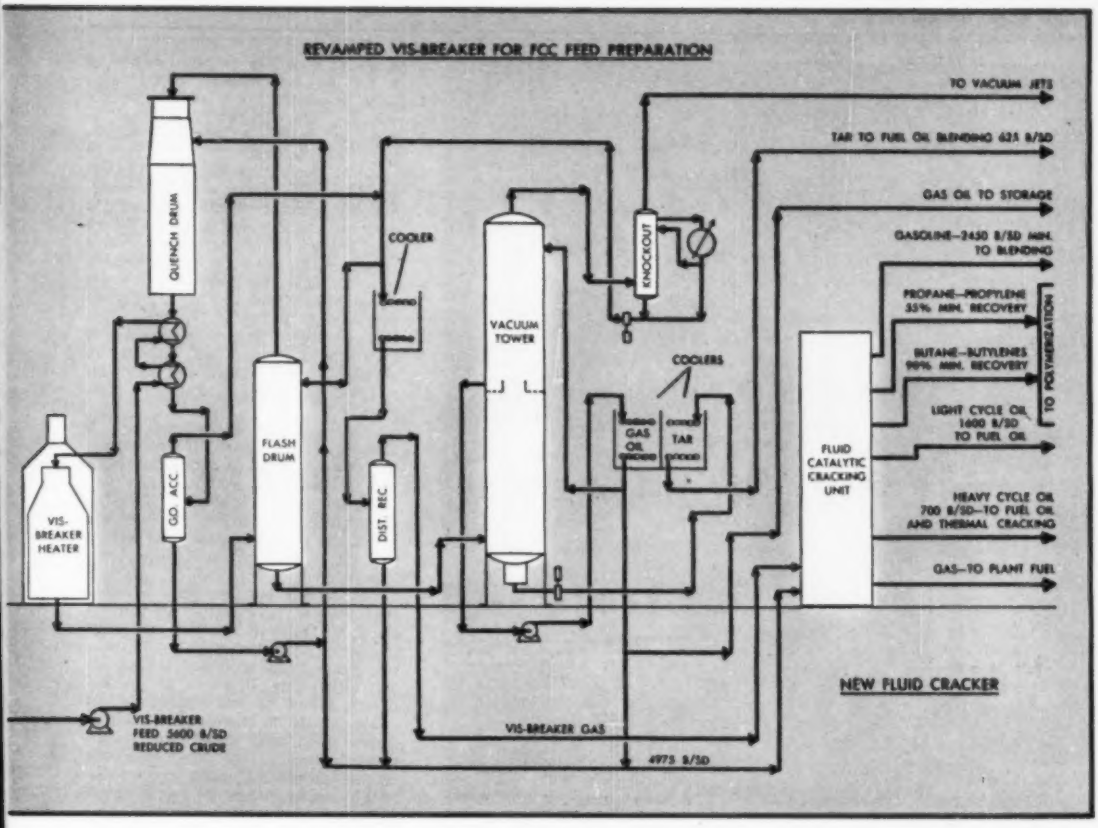
THE expansion program of the Cushing, Okla., refinery of Deep Rock Oil Corp., now practically complete, provides the plant with approximately 6000 b/d more crude capacity, a new crude topper, a 5000 b/d Fluid catalytic cracking unit, doubled throughput for the "polg" plant, 165,000 bbls. more product storage, a new research laboratory and other facilities. The project was started a little over a year ago as a major part of the reorganization of the Deep Rock company.

The plant will continue to produce high-quality premium and regular grade gasolines, kerosine and light fuels, jet fuels, diesel oils, heavy fuels, tars and road oils, a full line of lube oils, petrolatums and waxes, plus such specialties as paint thinners; cleaners' solvents and lacquer diluents.

Economics and the need for additional high-octane gasoline capacity dictated the modernization of this 30-year old plant. Total gasoline production has been increased 3000 b/d. The former continuous crude batteries remain in service, but a new, modern topper has been added to boost crude throughput. The old thermal cracking unit has been converted to a combination vis-breaker and thermal unit; the latter will be used later to process heavy catalytic cycle oil. Lube facilities remain unchanged, although economic studies on this portion of the plant continue.

The plant processes sweet Mid-Continent crudes in essentially two complete and separate operations. The first is the lube plant, utilizing a 4000 b/d continuous crude battery for topping, with lube stock separation by vacuum distillation and subsequent conventional refining. By-product light ends through gas oil are transferred to the "light oils section" of the refinery. This latter portion of the plant, shown schematically in Fig. 1, utilizes the new crude topping unit and an existing continuous crude battery to process a total of 14,000 b/d of crude. Reduced crude from both these toppers is vis-broken to catalytic unit feed stock, and the heavy vacuum bottoms are blended to fuel oil at the unit.

The new crude topping unit is



for the most part of conventional design. It has a two-coil Petro-Chem gas-fired heater having a 70% efficiency and heat duty of 12,000 MBtu./hr., a 24-plate fractionator with five side-to-side trays in the stripping section, and naphtha and distillate strippers in one shell. Provision also has been made for a third stripping column. Two Petreco desalters remove salt from crude charge to the new topping unit.

Here are produced straight-run gasoline, naphtha, distillate and reduced crude. An internal reflux circuit of light distillate is used in the fractionator, along with a trim reflux stream of light naphtha. Design and construction was by the Refinery Engineering Co.

The refinery's former thermal cracking plant had seperate vis-breaking and thermal cracking heaters and a vacuum column, in addition to the usual distillation equipment. One of the old heaters has been retained for vis-breaking service, operating on reduced crude from the two topping units and functioning as a feed preparation unit for Fluid catalytic cracking.

Heated charge is conventionally flashed, the gas oil overhead constituting the predominant volume of catalytic cracking feedstock. Flash tower bottoms product then is charged to a vacuum tower, the bottoms being of controlled specification. Gas oil produced on this tower likewise is catalytically cracked.

Revamping of the thermal cracking facilities still is underway. The second furnace of the former thermal cracking unit will charge the excess of heavy catalytic cycle oil not desired as fuel oil. The thermal gasoline resulting will be blended with the other gasoline stocks at the plant to regular and premium gasoline.

This Month's Cover Picture . . .

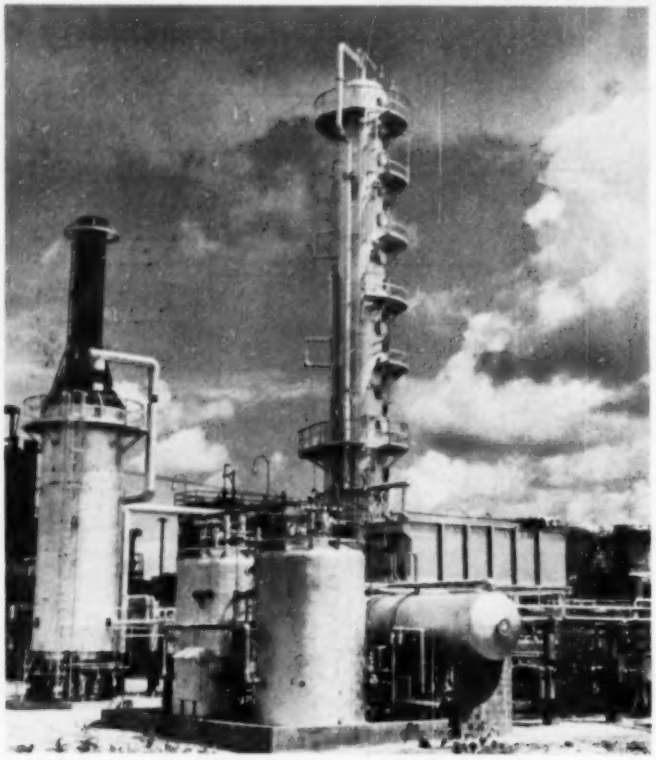
. . . shows new 5,000 b/d package-type Fluid catalytic cracking unit installed in modernized Deep Rock refinery. Control room in foreground fronts on county highway, gives passing motorists a glimpse of modern refinery operations. Pumphouse is at left, then main fractionator, Fluid unit and compressor house. Vessel behind control room is blowdown drum.

Heavy bottoms remaining after gas oil recovery will be blended with vacuum tower bottoms from vis-breaking for heavy fuel. Fractionating equipment in the thermal cracking portion of the old unit is being revamped also for maximum efficiency.

Catalytic Cracking

The 5000 b/d Fluid catalytic cracking unit, is the major new process installation at Cushing, having a design capacity of 4975 b/sd of gas oil. While the basic unit is the conventional Universal Oil Products Co. "package design" with graphic type panel, it has many novel features, all aimed at increasing operating simplicity and minimizing process upsets. Some are based on the operating experience gained from studying many other units, while others are original ideas of Deep Rock engineers.

An unusual feature from a processing standpoint is the sub-cooling of main column unstabilized overhead product. A conventional submerged-coil cooler is used to condence the major portion of the column overhead, using plant cooling water. Following this the product flows through coils in a separate pit,



NEW TOPPER augments continuous crude battery, has 5,000 b/d capacity. Left to right: heater, desalters, surge drum, distillation column, cooler boxes

for subcooling by water sprays brought directly from the cooling tower—the coldest water available. As a result, the maximum temperature anticipated in the overhead accumulator is 100° F., compared with the outlet temperature of 120° F. from the conventional overhead product condenser.

This feature gives optimum temperature control in the main tower and reduces the gas load on compressors at the gas recovery plant.

The main column also functions as a still for rich oil from the gas recovery plant absorber. It produces, in addition to unstabilized gasoline, light and heavy cycle oil streams. Some of the light cycle is used as absorption oil and the heavy cycle is used as the debutanizer reboiler heat medium. The balance is recycled, diverted to fuel oil, or thermally cracked as indicated earlier.

Actual operating data to date indicate that the catalytic cracking installation undoubtedly meets or exceeds design expectations. The unit has been charging a mixture of gas oil accumulated before the plant was brought down for tie-in and current production of catalytic charge stock from the feed preparation section.

Under design requirements, the vis-breaker is rated to charge 5600 b/sd of reduced crude, producing 4875 bbls. of catalytic unit feed and 625 bbls. maximum of vacuum tower bottoms (tar). The Fluid unit is guaranteed to produce a minimum of 2450 b/sd of 10-lb. Reid vapor pressure gasoline of 91 oct. Research, clear; 1600 bbls. minimum of light cycle oil and 700 bbls./minimum of heavy cycle oil. On basis of 4975 b/sd fresh feed, the catalyst consumption shall not exceed 0.5 lbs./bbl. and coke burning capacity must equal 4500 lbs. per hour. Catalyst is Type MS-A microspherical silica alumina. The gas recovery system is designed to recover 55% propane-propylene and 90% of the C_4 fractions.

Currently, on the special "clean" feed, the unit has operated much above the 52.75% conversion rate on which the total cycle oil production is predicated. Moreover, the unit went on-stream without any of the usual difficulties to be anticipated, much as would be expected following a routine maintenance turn-around. This is considered a tribute to the training that operators received as well as numerous unusual features built into the unit.

As a special precaution, a crew went over the piping, especially hangers and counterweighting, making a very accurate stress analysis before the unit ever went on-stream. As a result of this work, it was necessary to make only two minor adjustments on counterweights and to slightly alter hanger positions on two lines. In the words of one of the engineers: "We just kicked it off and it ran without a hitch." This unit was constructed by Jones & Laughlin Supply Co.

The Fluid unit is equipped with a graphic control panel for two principal reasons. First, it simplified training of inexperienced personnel and made for ease of operation, since the operator could readily and quickly select the proper control, even before his action became automatic from experience.

The second purpose was to cause the operator to visualize his actions as if he were controlling the unit manually. Oftentimes with older control systems the operator thinks, albeit incorrectly, in terms of the apparent effect of one instrument on another: "If I change this instrument, so, it will make that instrument do thus and so." Naturally, the second instrument reacts in response to processing behavior; not because some other control instrument was changed.

The graphic panel controls operation of the feed preparation (vis-breaking) unit, catalytic cracking, gas recovery and light ends stabilization as well as associated auxiliaries. The Panellit control installation has been extensively described previously; recording instruments are predominantly Foxboro.

Regenerator Innovations

One of several unusual auxiliaries in the regenerator is a second quench spray system, manually controlled like the conventional quench located about the middle of this vessel, to afford better control of afterburning. Between the two quenches and the other conventional safety controls built into the regenerator, there is little chance of damaging either catalyst or refractory by excessive temperatures. Further protection is provided by cooling coils through which light cycle oil is circulated; the material will not crack under conditions prevailing.

Spent catalyst enters the regenerator at the conventional midpoint. However, instead of terminating here, the line extends into the interior approximately 5 ft., so that catalyst enters the dense rather than the light phase in the interior. This, too, im-

proves control of coke burning conditions.

An unusual scheme was worked out to double seal the regenerated catalyst outlet leg as a protection against catalyst erosion of the seal. At Cushing this pipe is sealed on both sides of the air distribution grating, using a "home-made" seal. Two boxes of light steel plate having no bottoms are welded to pipe and plate on both sides of the distribution plate. The one on top is conventional. However, the air distribution ports adjacent have been rearranged to minimize impingement erosion while air distribution has not been significantly altered.

A common trouble in the event of air blower failure is the entry of catalyst into the check valve on the unit side of the blower, oftentimes into the blower itself, should the check valve be sluggish. Deep Rock's unit uses a positive-operating hydraulic piston, attached to the check valve flapper and under control of a differential pressure-actuated pilot. This is so set that, when the differential pressure across the valve drops to zero, the valve automatically closes. It remains closed, regardless of further differential pressure changes, until the main blower is in operation and the valve has been opened manually. Thus the check valve positively closes long before any backflow of catalyst can reach either valve or blower.

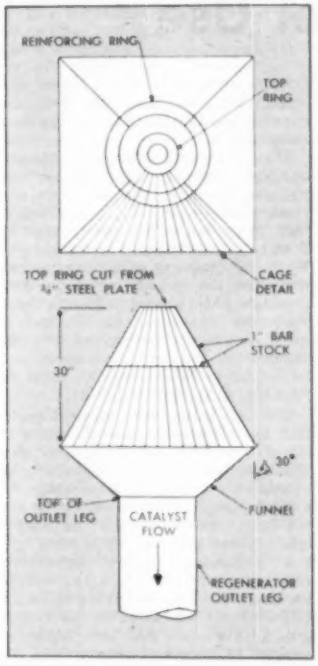
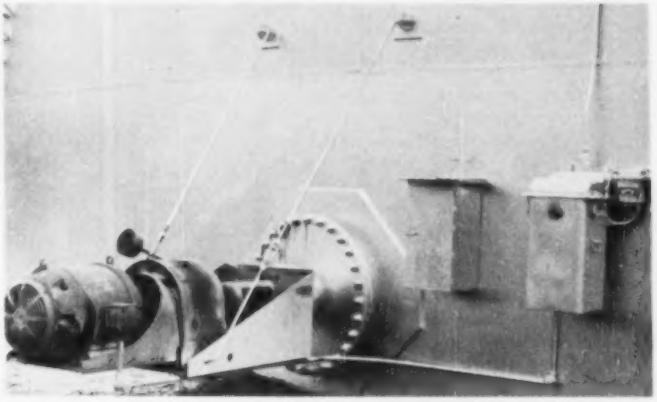


FIG. 2—Cage mounted on regenerated catalyst outlet pipe helps prevent bridging. Details described in text



MIXER on 50,000-bbl. gasoline blending tank at Deep Rock is rated to move 30,000 gal. of product a minute, completely blending mixture of catalytic, straight run, thermal and polymer gasolines for pipe line delivery in 4 to 6 hrs. Propeller is 28 in. in diameter, runs at 425 RPM, and is driven by 25 HP electric motor, mounted at 10 degrees to left of tank diameter

The catalyst outlet pipe from the regenerator not uncommonly becomes blocked, often because of a piece of refractory becoming detached from the regenerator walls and falling into the pipe. Deep Rock's engineers conceived a "cage" to place over the funnel on the outlet leg from the regenerator to prevent this. The drawing, Fig. 2, illustrates the arrangement and construction. The 1-in. bars forming the truncated cone-shaped cage are welded to the perhiphery of the hopper forming the outlet leg entrance, with a disc, cut from ¾-in. carbon steel plate, at the top. Midway, the cage is reinforced with a bar stock ring. Additional bars are placed in the lower half of the cage as fill-ins.

The hydraulic system actuating the slide-valves is filled with a 50-50 mixture of ethylene glycol (commercial antifreeze) and water, inhibited against corrosion. The freezing point of the mixture is —10° F. Viscosity changes are negligible over the anticipated operating temperature range.

A 1-in. diameter line by-passing the standard 4-in. transfer line from fresh catalyst storage to the renegerator has been installed to permit catalyst make-up at much lower rates when desired. It is anticipated the large line will be used only when refilling the unit. Catalyst storage, incidentally, was formerly the clay desulfurization reactors for the old thermal cracking unit.

An ingenious arrangement has been installed in conjunction with the waste heat boiler to facilitate the water level control in this vessel. The cracking unit consumes 45,000 lbs./hr. of 125-lb. steam, of which 35,000 lbs. is generated by waste heat. A surge tank is connected to the system and, with a vertical tank nearby, forms a U-tube on which level controls are mounted.

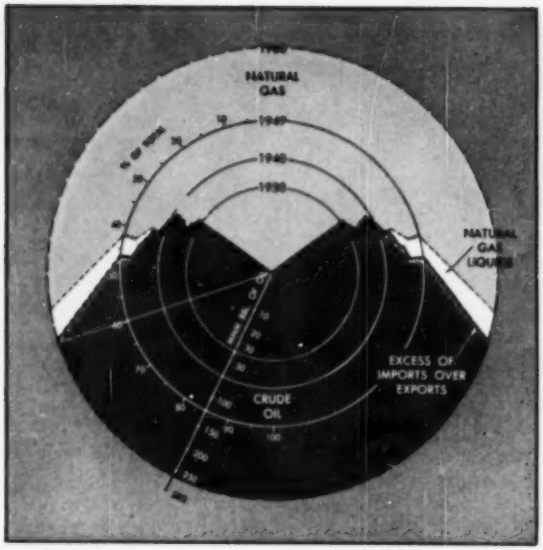
The high-level controller actuates a pump which returns feedwater to the plant boilerhouse feedwater storage. Similarly, the low-level controller opens the line from boilerhouse feedwater stoarge to the surge tank, allowing feedwater to enter the system. All driving equipment at the Fluid unit runs full-condensing.

Other Facilities

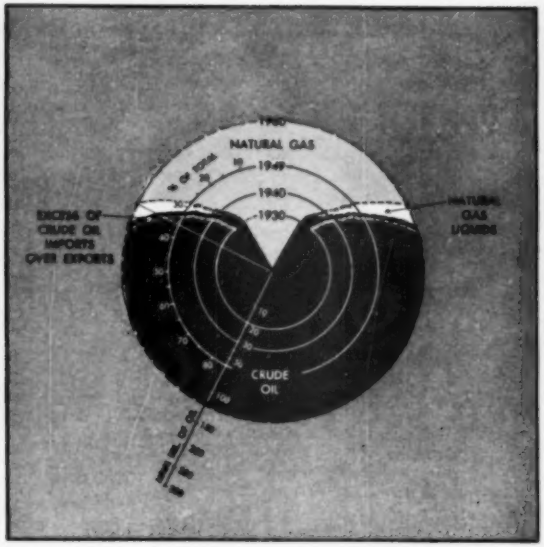
Coincident with completion of new research facilities at the Cushing refinery has been the reorganization and expansion of the research and development department under direction of Dr. N. K. Anderson. There now are four sections: products application; engine fuels and lubricants; pilot plant, and the chemical laboratory.

Other changes still are in prospect at Cushing. With the addition of the new units and increased plant throughput, the mechanical shops and warehouse department are being reorganized. A new warehouse inventory system is being installed, with further revisions contemplated, and an improved preventive maintenance system is in process of development.

Employes of such departments as accounting have recently undergone training to familiarize them with the new refinery set-up, the policy of Deep Rock being that the accuracy of cost records is only as good as the accuracy of the knowledge by which costs are apportioned.



DISCOVERIES—Fig. 1—Cumulative U.S. discoveries of petroleum



CONSUMPTION—Fig. 2—Cumulative consumption in the U.S.

The Availability of LPG For Direct Motor Fuel Use

By R. C. ALDEN, Chairman
Research Planning Board
Phillips Petroleum Co.
Bartlesville, Okla.

TO CHALLENGE the imagination this discussion begins with the assertion that the large scale use of liquefied petroleum gas as a direct motor fuel appears to be as inevitable as tomorrow's sunrise. Assuming for the moment this premise is correct and facing the prospect with very little past experience, there is an unparalleled opportunity to build an enduring foundation for the future.

With very few past mistakes to live down, all the interests concerned —the many branches of the petroleum industry, the equipment manufacturers, transportation companies, legislative and regulatory bodies, the other consumers—can and should cooperate to get the most out of liquefied petroleum gas as a direct motor fuel in trucks and buses, and in tractors and many other non-highway uses.

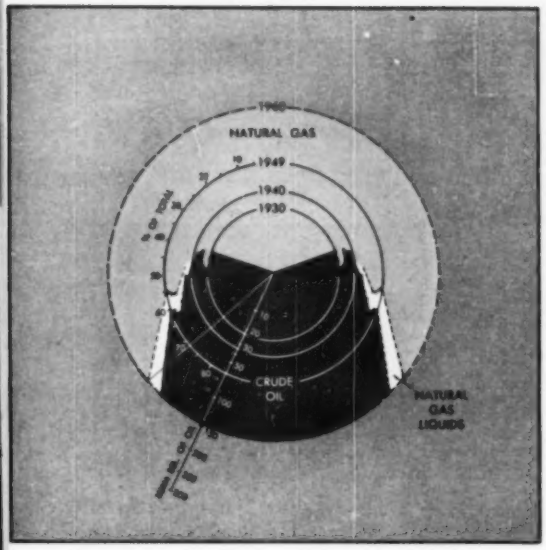
The development of a large scale motor fuel market for LPG is a tremendous undertaking. There are and will be many people and interests who will not like to see LPG in wide use as a motor fuel. They will throw up road blocks everywhere. One of the chief arguments such people have is that LPG is not available in sufficient quantities to merit the effort and cost of developing the necessary equipment, facilities and services. This argument states it is futile to consider LPG as available for the long range as a motor fuel because it is a limited by-product of natural gas and refinery operations and because it is very valuable for conversion into high-octane aviation gasoline and chemicals and for domestic fuel and for many other uses.

Further, the argument states these conclusions are substantiated by the experience in California, where a very strong effort was made to use LPG as a motor fuel. There, many former users have retreated from this venture, discouraged by short and long-term shortages and by high prices. On the other hand, active proponents assert that the potential annual volume of LPG is many times any conceivable demand.

All of this illustrates how easy it is to reach a preconceived conclusion and particularly if that conclusion is the one that favors your particular interest. As we have delved into this subject of the availability of LPG we have had to revise quite a number of preconceived ideas. For example, how do you answer the simple question: Why the sudden enthusiasm for LPG in 1950 as a direct motor fuel when everyone from the very beginning has known that it is an ideal motor fuel?

My preconceived answer to this question was that the potential supply was formerly too small, is currently quite large and is growing so fast that large new markets must be found for liquefied petroleum gas. Well, the facts, as nearly as one can interpret them, only partially substantiate this answer. Potential supplies are increasing but not at as great a rate as consumption. The full answer for the 1950 enthusiasm for LPG as a direct motor fuel must be found in a number of places.

The fact of greatest significance is that the oil industry is awakening to the full implications of natural gas. The reserves of crude oil have been estimated annually very carefully for a long period of years. However, for the first time in 1946 and for subsequent years reserves of natural gas and "natural gas liquids" have been officially estimated on a basis comparable with the estimates of crude oil reserves. Previous estimates of natural gas reserves had been made by various experts and natural gas enthusiasts but these estimates did not command the confidence and respect of the recent API-AGA estimates. Thus, because there has been a better



RESERVES—Fig. 3—U.S. reserves of petroleum

The extent of our present natural gas reserves and the anticipated high rate of discovery of such reserves in the coming decade makes the recovery and utilization of liquids extracted from natural gas a matter of major concern to the petroleum industry.

Analysis of the various uses for motor fuel leads to the conclusion that the full potential domestic commercial motor fuel market (truck and bus, and tractor and other non-highway uses) would require a supply of liquefied petroleum gas equal to nearly 45% of motor fuel production. Capture by LPG in the next 10 years of half this market would provide an increment of motor fuel equivalent to approximately 20% of total motor fuel production. This would be of paramount usefulness in cushioning the civilian economy against the impact of military requirements for gasoline in wartime.

While future large-volume LPG production would necessarily be at higher manufacturing costs, the experience of the natural gasoline industry leads to the conclusion LPG could be economically produced and marketed for direct motor fuel use at several cents under the price of other motor fuels.

statistical bookkeeping system for our natural gas reserves during the last 5 years we are in a better position to size up the situation in regard to matters relating to natural gas.

In this connection it is interesting to note that the early unofficial estimates of natural gas reserves must have been nearly correct because they fit in pretty well with many relationships established by the recent official estimates. More importantly, on a Btu. basis our reserves of natural gas are greater than our reserves of crude oil. It is also of great significance that, although our consumption of natural gas is increasing faster than is our consumption of crude oil, the reserves of natural gas are increasing still more rapidly.

In Figs. 1, 2 and 3 we have attempted to show graphically how this situation has been changing and may change in the future. These figures are radial graphs showing our cumulative discoveries, cumulative consumption and reserves of natural gas, natural gas liquids and crude oil. The areas are proportional to the quantities of the several materials shown with natural gas converted to barrels of 36° API crude oil on a Btu. basis. Imports of crude oil are included in the discoveries and consumption graphs. The circles show the magnitudes for the indicated years. In addition, there is shown a projection to the year 1960 on the premise that certain past trends will continue into the future. This projection is open to all sorts of reservations and particularly in regard to new discoveries. However, as long as natural gas discoveries exceed crude oil discoveries the chief effect of lesser discoveries would be to shorten the diameters of the circles representing the year 1960.

The diagram (Fig. 1) on cumulative discoveries shows we have been discovering natural gas in recent years much faster than we have discovered crude oil and to such an extent that, if past trends continue to 1960, our cumulative discoveries of natural gas will constitute 55% of the total petroleum discovered. This compares with 1930 when the cumulative discoveries of natural gas were only 30% of the total.

Fig. 2, which shows the cumulative consumption of petroleum, presents quite a contrast in that it demonstrates the relatively small use that has been made of natural gas. Even at the accelerating rate of natural gas usage the extrapolation of past trends indicates that our cumulative consumption of natural gas will be only 35% of our total petroleum consumption in 1960. In 1930 it was only 17%.

Fig. 3 shows the effect of these two basic factors on petroleum reserves. This diagram presents a startling contrast with the other two and is of greater significance because it portrays, in part, the road ahead. Extrapolating past trends to 1960 it is concluded our natural gas reserves will be 72% of the total petroleum. In 1930 they were 34%.

These three diagrams demonstrate that natural gas and natural gas liq-

Meet the Author

R. C. Alden, chairman of the Research Planning Board for Phillips Petroleum Co., started in the petroleum industry in 1920, two years after being graduated from Lehigh University. In 1921 he became a research chemist for Chestnut and Smith Corp., in Oklahoma and Texas. Later he was a partner in Seeley-Oberfell Engineering Corp., Breckenridge, Texas, and then superintendent of Landreth Gasoline Co.'s natural-gasoline plant in Ibex, Texas. This was followed by sales engineering activities in California for Gasoline Recovery Corp. In 1925 he joined the research staff of Phillips as a senior chemist. In 1930 he was made assistant director of research and director of research in 1933. With Phillips he has played an active part in the company's pioneering developments in the field of processes for the conversion of gaseous hydrocarbons to liquid fuels, and the development of petroleum engineering and natural gasoline technologies.

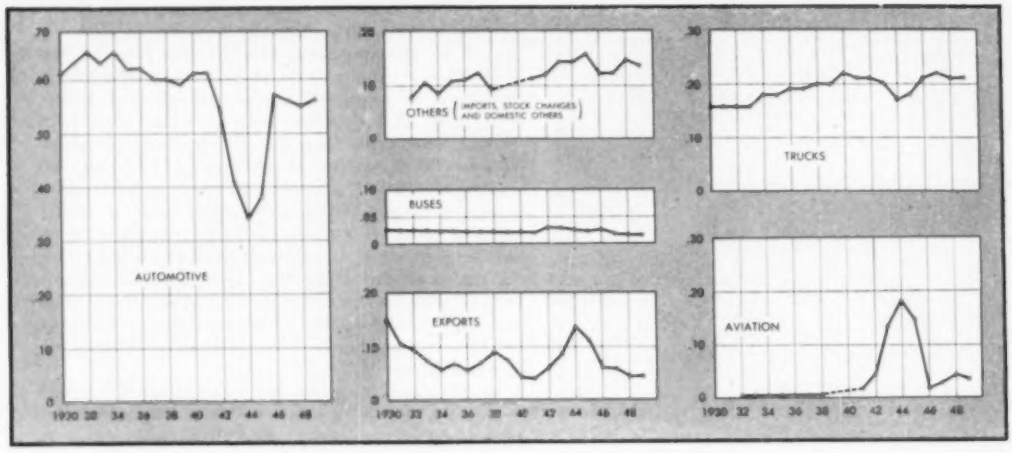


FIG. 4—Uses of motor fuel (ratio to total)

uids have, willy-nilly, become a matter of major concern to the petroleum industry. Fig. 3, in effect says, if the petroleum industry is to continue in its role as the leading Btu. producer and marketer to the American public it must develop ways and means of cashing in on these very considerable reserves of natural gas. The current rapid development of natural gas pipe lines is an important step in this direction.

Another important step is to remove the natural gas liquids from the natural gas as it is produced and put them in the high value liquid fuel markets rather than in the low value gas markets.

Although many in the oil industry have realized the basic facts set forth in Figs. 1, 2, and 3, it is only in recent years with the advent of official estimates of natural gas reserves that the entire industry has become aware of the stark fact that more than half its producible raw material is natural gas. And such widespread awareness is necessary to make liquefied petroleum gas a success as a direct motor fuel, for it will require the full effort of much of the oil industry. It cannot be achieved on a large scale by any one company or even by any group of companies. It is a situation where competition of all comers should be welcomed. And I think the basic facts set forth in Figs. 1, 2 and 3 will very quickly convince the doubting Thomases in the oil industry of the economic desirability of upgrading the market value of natural gas by any and all feasible methods.

One of the difficulties in appraising any petroleum problem is that everything related to petroleum increases year after year. For example, it is the delight of petroleum statisticians to ask the question; What is the biggest yield of any product from crude oil? The unwary will reply; "We got about 50% of gasoline from crude oil several years ago. Of course, that is not the correct answer. The correct answer is that prior to 1900 we were getting more than 60% of kerosine from the crude oil refined. But even more amazing than this startling fact is the fact that in 1949 with the kerosine yield at only 5.3% of the crude oil refined, the production of kerosine was three to four times the 1900 production.

To overcome, at least in part, this difficulty of dealing with an ever expanding industry, subsequent statistical studies have been reduced to a sort of common denominator. Because we are interested in a motor fuel market we have selected gasoline production as the most significant common denominator for our purposes, although any of a number of other common denominators might have been nearly as useful. Thus, in Fig. 4, we attempt to define the size of the commercial transportation market for motor fuel. In Figs. 5, 6, and 7 we attempt to appraise the potentialities of the supply of liquefied petroleum gas. And in Figs. 8 and 9 we examine the situation in regard to other liquid petroleum fuels and particularly of "the middle of the barrel" for potential supplies of Diesel fuel. In all of these studies, the common denominator is "a gallon of motor fuel produced (or producible)".

Table 1—Relative Size of Commercial and Non-Highway Uses of Gasoline

(Percentages of motor fuel production)

	1930	1949	1960
Trucks	16.0	21.0	21.8
Buses	2.5	1.5	1.0
Others	6.5	13.6	17.5
Tractors(*)	0.2	1.5	2.2
Total	25.2	37.6	44.5

(*) Estimated. Not strictly motor fuel production.

In considering the question of availability of any material one of the first questions to be answered is the magnitude of the demand which the availability must satisfy. It is generally agreed that LPG as a motor fuel can expect success primarily in the truck and bus highway markets and in the tractor and other non-highway uses for gasoline. Aviation uses, of course, are out of the question, although a current news item describes a four-place Aeronca adapted for operation on "liquefied propane gas."

In Fig. 4, the various uses of the motor fuel produced as a proportion of the total is shown for the years 1930 to 1949 inclusive. The important thing in Fig. 4 for our purposes is the relative size of the commercial and non-highway uses of gasoline. These uses as of 1930 and 1949, with a guess for 1960, as percentages of the motor fuel production are shown in Table 1.

From this analysis it may be concluded the full potential domestic commercial motor fuel market will require a supply of LPG equal to nearly 45% of the motor fuel production. Actually, of course, if in the next ten years as much as half of this market could be captured for LPG it would be a tremendous achievement. And in still more detail it is quite likely that the extent to which the several markets can be captured will vary considerably, with most rapid success in the smaller volume markets. From these considerations it is finally concluded that, to assure prospective motor fuel users and equipment manufacturers of an adequate availabity of LPG for commercial motor fuel uses it is necessary to see ahead a practical and realistic availability of LPG equivalent to from 10 to 20% of the normal motor fuel production with

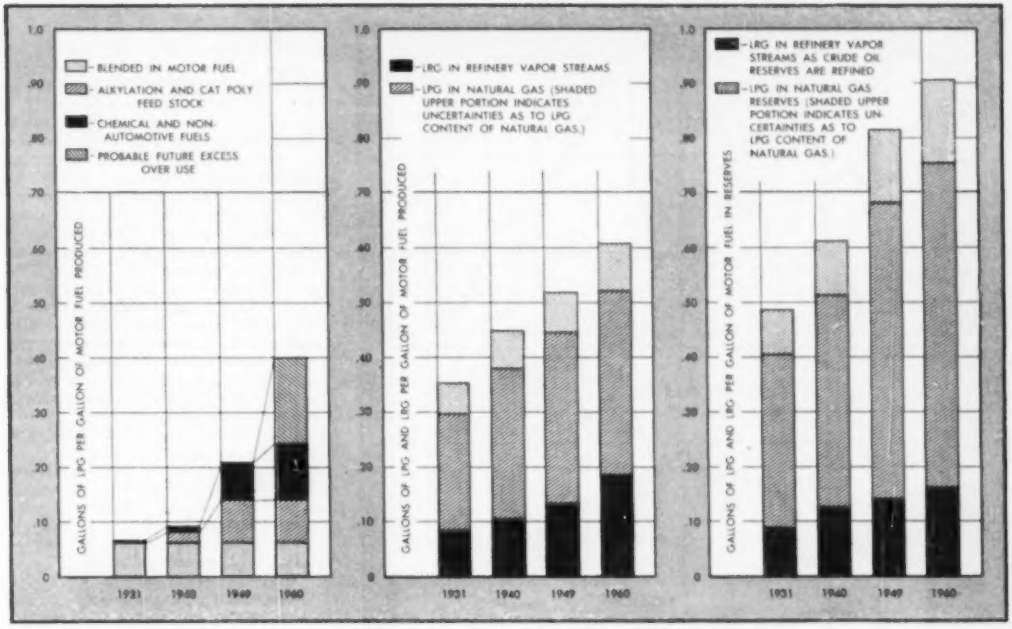

BLENDED IN MOTOR FUEL
ALKYLATION AND CAT POLY FEED STOCK
CHEMICAL AND NON-AUTOMOTIVE FUELS
PROBABLE FUTURE EXCESS OVER USE
GALLONS OF LPG PER GALLON OF MOTOR FUEL PRODUCED
1.0
.90
.80
.70
.60
.50
.40
.30
.20
.10
0
1931
1940
1949
1960
LRG IN REFINERY VAPOR STREAMS
LPG IN NATURAL GAS (SHADED UPPER PORTION INDICATES UNCERTAINTIES AS TO LPG CONTENT OF NATURAL GAS.)
GALLONS OF LPG AND LRG PER GALLON OF MOTOR FUEL PRODUCED
LRG IN REFINERY VAPOR STREAMS AS CRUDE OIL RESERVES ARE REFINED
LPG IN NATURAL GAS RESERVES (SHADED UPPER PORTION INDICATES UNCERTAINTIES AS TO LPG CONTENT OF NATURAL GAS.)
GALLONS OF LPG AND LRG PER GALLON OF MOTOR FUEL IN RESERVES

FIG. 5—Production of LPG and LRG for consumption in established uses (relative to motor fuel production)

FIG. 6—Total potential LPG in natural gas produced and LRG from crude oil run at refineries (relative to motor fuel production)

FIG. 7—Total potential LPG in natural gas reserves and LRG from crude oil reserves (relative to motor fuel in reserves)

the possibility of still higher production rates subsequently.

Before leaving Fig. 4, it is worth noting how LPG as a motor fuel could be of paramount usefulness in cushioning the essential civilian economy against the impact of military requirements for gasoline in wartime. The tremendous wartime requirements for aviation gasoline and military motor fuel (see Exports) are offset by large drops in automotive and truck uses. An increment of motor fuel equivalent to 20% of the total production would greatly alleviate this situation, not only quantitatively but from the viewpoint of quality of gasoline for both military and civilian use. The developments we have projected to 1960 might be consummated in a much shorter period under the stress of an immediate war.

The next aspect we have examined is the past and probable trends in the actual production and consumption of liquefied petroleum gas. This analysis is shown in Fig. 5. The diagram may be a surprise to some, for many have the opinion that the production of LPG is increasing at the rate of 30 or 40% a year. Fig. 5 shows that total relative production increased only 50% between 1931 and 1940 and 133% from 1940 to 1949. An increase of only 90% is projected for the period from 1949 to 1960.

Actually, Fig. 5 represents the consumption of LPG rather than the production. Thus it is noted in 1931, the consumption of LPG was limited to the 6% used in blending motor fuel to vapor pressure specifications, although the so-called LPG industry had made a small impression. By 1940, the use of LPG for "cat poly" and alkylation feed stocks had gotten underway and the liquefied petroleum gas industry had expanded several fold. The use for motor fuel blending remains constant at 6% throughout. By 1949 under the stimulus of wartime "cat crackers" and alkylation plants and the postwar octane number race, the use of LPG for synthetic gasoline manufacture increased very rapidly. During this interval the chemical and non-automotive fuel use of LPG also increased at a very great rate.

The considerable amount of liquefied petroleum gas easily or actually recovered but diverted to very low value fuel uses is not estimated in Fig. 5.

The projection to 1960 in Fig. 5 is based on several extrapolations, each subject to variations in opinion. There is probably little to question in regard to the assumption that LPG blended in motor fuel will remain unchanged at 6%. The assumption that use for synthetic gasoline will remain constant is perhaps the most questionable. These operations are very sensitive to alternate use values for LPG on the one hand and the value of the synthetic gasolines on the other hand. Thus, for the manufacture of high octane military aviation gasoline during a war, where any cost within reason can be paid, this relative use of LPG might almost double. On the other hand, under more normal circumstances, a substantial increase in the market value of LPG would undoubtedly result in a much lesser use for this purpose.

The use of LPG as a chemical raw material and as a non-automotive fuel is projected to the future at a much lower rate of increase than has prevailed in the past. This is based on two major assumptions (1) that in some of the established uses a saturation point is being reached and (2) that in all these uses, LPG as well as other liquid fuels will lose some ground to natural gas. Continued rapid increases are anticipated in the chemical uses. Over and above these assumptions is the further general assumption there will be an increase in the field price of LPG which will force it from some uses where it is presently only marginally competitive with other energy sources.

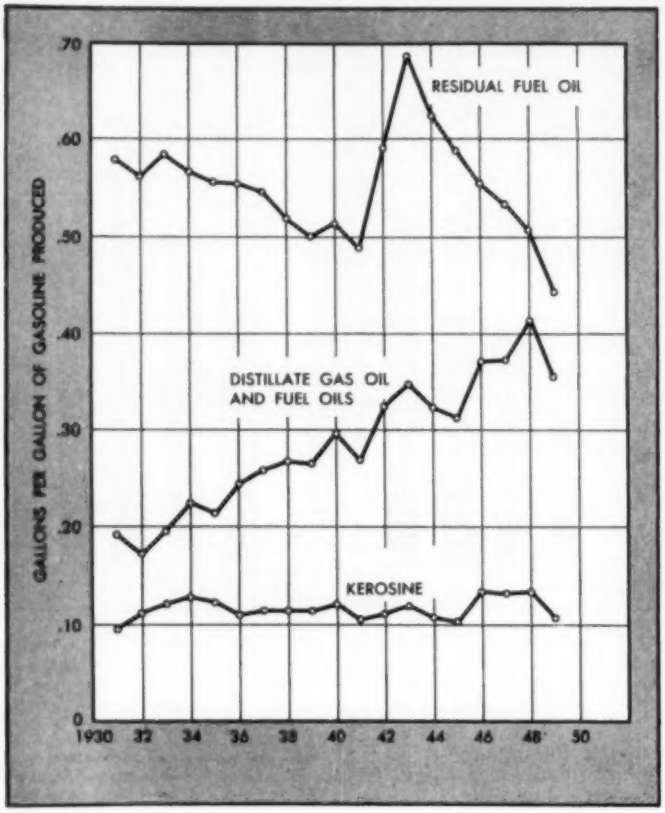


FIG. 8—Comparison of production of liquid fuels with gasoline production

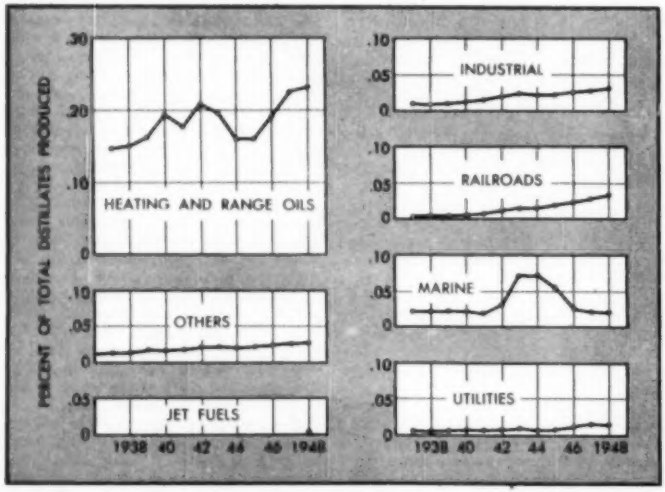


FIG. 9—The struggle for the "middle of the barrel" (distillate, gas and fuel oils)

In regard to the extrapolation to 1960 of the total production several major technical and economic considerations support the estimate in Fig. 5. The major consideration is that more and more natural gas is being handled at high pressures and in large volumes. Under these circumstances it becomes economically feasible to extract liquefied petroleum gas at high extraction efficiencies. Another important consideration is that modern cracking procedures not only have increased the yield of LPG from crude oil but also provided very rich refinery vapor streams containing much larger proportions of high value olefinic liquefied petroleum gas. Here again extraction facilities have an easier load than formerly and in addition have added incentives toward higher efficiencies.

From these and other considerations it is concluded there will be production facilities for LPG for quantities considerably in excess of presently established uses. The estimate made in Fig. 5 is that this excess can be as much as 16% of the motor fuel production in 1960.

From our study of Fig. 4 we concluded that a potential supply of from 10 to 20% of the motor fuel production is needed some time in the future to justify serious consideration of liquefied petroleum gas as a motor fuel. The 16% increment predicted in Fig. 5 provides this much assurance. There remains the question of still larger supplies for the longer term future and the related question of whether the total potential supply is sufficiently great to permit the higher rates of production.

In Fig. 6 we have appraised the potential supply situation by estimating the LPG in the natural gas produced and that resulting from refinery operations. Without going into detail as to the methods of arriving at these estimates there is some uncertainty throughout, probably on the high side, as indicated, for the total LPG in natural gas. Offsetting this is an uncertainty (not indicated) of about equal magnitude but in the opposite direction and chiefly for the years 1949 and 1960 for the LPG produced in refinery operations. The net result is that the total potential availability may be somewhat lower than the indicated top lines for 1931 and 1940 and about at the top lines for 1949 and 1960. Incidentally, the quantitative availability in 1949 is 21 billion gallons.

Fig. 6 shows there has always been a considerable potential supply of LPG relative to motor fuel and that this supply is increasing so as to add 10% increments about every ten years. Looking forward to 1960 there is plenty of room to increase production of LPG to the levels necessary to capture more than 15% of the motor fuel market. The trends certainly

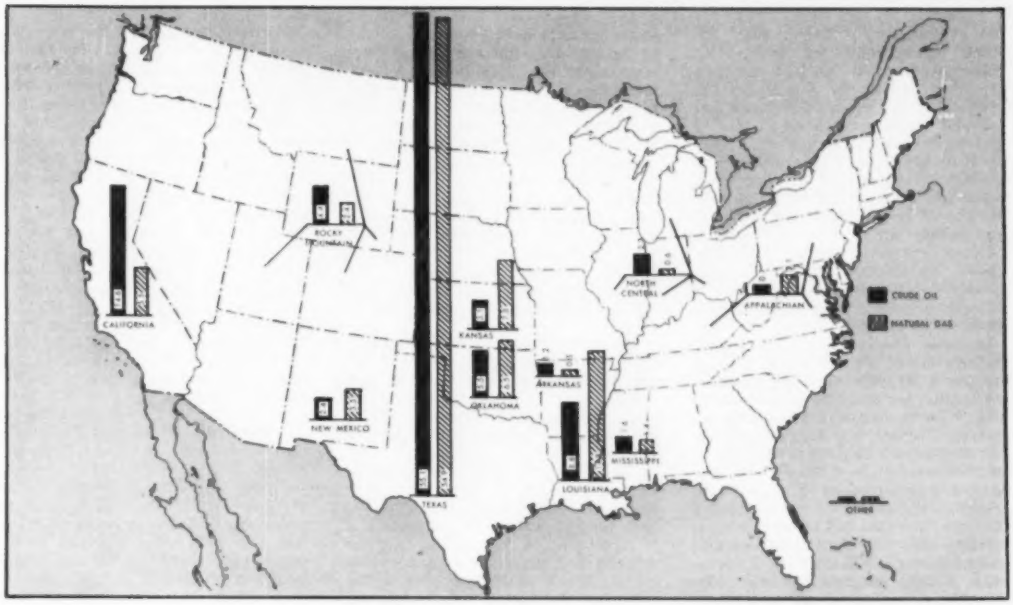


FIG. 10—Geographical location of reserves—per cent

indicate that production can be increased to still higher levels in the longer term future.

Fig. 7 is another way of looking at the availability of LPG. This graph represents an estimate of the LPG and motor fuel producible from our reserves of crude oil, natural gas liquids and natural gas. It will undoubtedly startle many to know that the LPG potential of our petroleum reserves may soon equal the potential for motor fuel. Although strictly a matter for long range consideration the trend indicated in Fig. 7 should convince those who doubt or question the long term availability of liquefied petroleum gas.

There are numerous uncertainties involved in estimates of the kind presented in Figs. 6 and 7. In some regards the basic data are quite accurate or at any rate there are very convincing statistics to support them. In other regards it has been necessary to estimate basic facts. The most difficult basic facts to rationalize have been the propane and butane contents of the average natural gas and the average yield of liquefied petroleum gas in the refining of crude oil. For the record, Table 2 shows the premises used for these factors in these estimates.

It is realized many things can happen to invalidate the projections to 1960. Nevertheless these projections have been included as an indication of what may happen rather than as a prediction of what will happen.

There are two other major phases of availability which merit consideration in this discussion.

First, there is the question of geographic availability. It is asserted by some that LPG is far removed from its markets. Well, this is true but the same thing can be said of the motor fuel and Diesel fuel derived from crude oil. This is demonstrated in Fig. 10, which shows the geographic distribution of our natural gas and crude oil reserves. There is not much to choose between the two kinds of motor fuel. Incidentally, Fig. 10 indicates the shortages of LPG encountered in California are not nearly so likely to occur in other areas.

Second, there is the question of price availability. Here, the argument on the other side of the fence is that the price of LPG will go sky high as soon as enough consumers are committed to its use. Also that the price of LPG fluctuates violently. On these points we can only speculate. It should be thoroughly understood, however, that the development of LPG uses so far has been based on the "cream of the crop" cost-wise. Future increments of LPG production will be necessarily at higher manufacturing costs.

In judging the magnitude of these manufacturing costs it is useful to point to the fact that the economics of extraction of LPG from natural gas at the higher pressures, higher yields and larger volumes now common is roughly analogous to that of the extraction of natural gasoline from natural gas at the lower pressures, lower yields and smaller volumes which have prevailed in the past for this operation. From this analogy one would conclude that liquefied petroleum gas can be economically manufactured and marketed at several cents under motor fuel as has been the case with natural gasoline. As for the violent fluctuations in the price of liquefied petroleum gas this no doubt is a symptom in part of a relatively small market and on this assumption price should become more stable as the size of the market increases. It is to be hoped, of course, that those responsible for price policies will, within their powers, try to maintain reasonably stable prices.

No discussion of LPG availability for motor fuel uses would be complete without some consideration of

Table 2—Liquefied Petroleum Gas Factors Used in Calculating Potential Supply in Production (Fig. 6) and in Reserves (Fig. 7)

	C_3 and C_4 Content of Natural Gas (Bbl. per MM Cu. Ft.)		Yield of C_3 and C_4 in Refining (% of Crude Oil)	
	Production	Reserves	Production	Reserves
1931	70	60	4.6	4.7
1940	70	55	4.9	6.3
1949	55	48	6.5	7.2
1960	50	40	8.0	9.0

the availability of Diesel fuel, the other logical fuel for commercial transportation and non-highway uses of motor fuel. In Fig. 8 is shown the production of kerosine, distillates and residual fuel oils, each as a ratio of the motor fuel production from 1931 to 1949 inclusive. The relative production of kerosine is low and comparatively constant. The relative production of residual fuel oil is declining rapidly with a wartime reversal upward reflecting high naval requirements. The relative production of distillates is increasing rapidly. There is every indication these trends will continue in the future.

Because Diesel fuel comes almost entirely from the distillates it is of interest to appraise the uses to which distillates are put. This is done in Fig. 9 for the years 1937 to 1948 inclusive. By far the biggest market for distillates is as heating oils, where in the 12-year period the relative production has increased from 14.8% to 35.0%. This upward trend suffered a wartime reversal which was almost exactly offset by the increased naval requirements reflected in marine uses. All the other uses of distillates have been increasing during this period with railroad dieselization leading in the rate of increase. In 1948, a new competitor for the "middle of the barrel" entered the statistical records in the form of jet fuels. Of the total 1948 consumption of distillates 26.2% was characterized as Diesel fuel, of which more than four-fifths went to other than highway uses. In terms of our common denominator this means that Diesel fuel equivalent to less than 2% of the motor fuel production was used for highway purposes.

From these facts one is forced to the conclusion that the Diesel engine for highway use has not been able to compete very successfully for the "middle of the barrel". Other large high value demands have brought about increased yields of distillates from crude oil but this has caused the price of distillates to reflect more closely the cost of crude oil and the market value of motor fuel. With all these relatively high value demands on the "middle of the barrel" of crude oil, including its high value as feed stock to cracking operations, it is difficult indeed to visualize, except at much higher prices, a substantial increment for highway use.

Whereas the highway Diesel engine is in intense competition with many other consumers for a limited fraction of crude oil, the liquefied petroleum gas is faced in the immediate future with a large excess of production which will be seeking new or enlarged markets. Further, the basic cost elements relating to liquefied petroleum gas are not so closely related to crude oil and motor fuel costs as in the case of Diesel fuel.

In these discussions, because the statistics have been expressed mostly as ratios, the impression may have been given that LPG is not a very big thing. Actually it is a tremendous thing. Even a fraction of a per cent of the gigantic petroleum industry is a large quantity. Thus, 15% of the estimated motor fuel market of 1960 will be over 9 billion gallons and if this is added to the estimated 6 billion gallons for chemical, domestic, industrial and utility uses there will be a total sales of 15 billion gallons of LPG for other than refinery uses, which figure may be compared with 2.8 billion gallons of such sales in 1949.

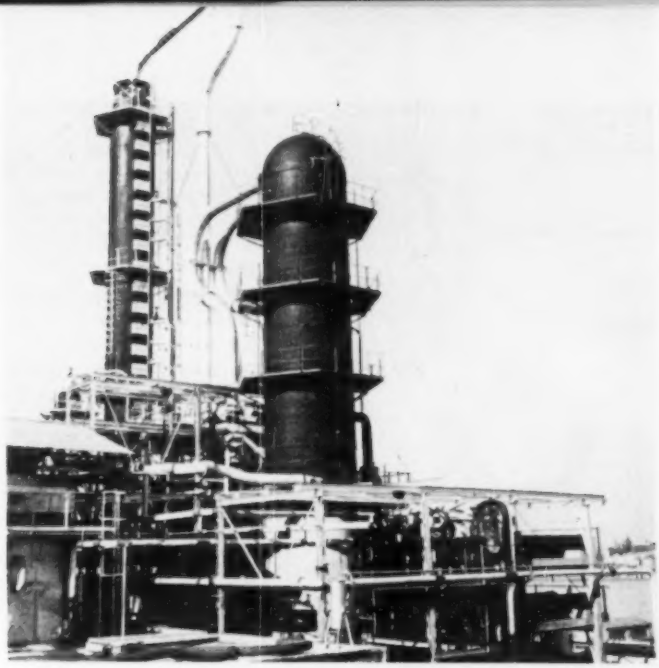
Nearly all the gross income derived from the natural gas portion of the new volumes will represent an increase over that obtainable if the LPG is not extracted because LPG brings in considerably less than one cent per gallon as natural gas. Thus, if the average yield of LPG from natural gas can be raised one gallon per 1000 cu. ft. and the LPG can command a price of 6c per gallon it is equivalent to raising the value of natural gas more than 5c per 1000 cu. ft., which in turn applied to the estimated volume of natural gas for 1960 means added gross income from production of natural gas of about $600,000,000 per year.

These calculations are mentioned to emphasize the fact that the entry of liquefied petroleum gas into the motor fuel market is a truly gigantic undertaking which will have many repercussions not only in the petroleum industry but in many other industries. Success in the venture will call for a stupendous effort, much investment and above all the enthusiasm and imagination of the proponents. There will be many obstacles and many obstructionists. Although we cannot now foresee them there may be reasons we have overlooked or new developments which will make the effort eventually unsound. However, from the studies we have made to date, availability of LPG, both the immediate practical availability and the long range potential availability, is sufficient with a considerable margin of safety.

In conclusion, I would like to revert to Figs. 1, 2, and 3 for an analogy which I think drives home everything I have said. In these diagrams, if you have enough imagination, you can visualize apples in varying stages of growth and ripeness. The crude oil represents the ripe, red, tasty, and digestible portion. The natural gas represents the unripe, green, unsavory, and indigestible portion. Fig. 1, our cumulative discoveries, represents the half ripe apple we have grown. Fig. 2, our cumulative consumption, represents the three quarter ripe apple we have eaten. Fig. 3, our reserves, represents the quarter ripe apple we have left to eat. It looks pretty indigestible. Calling further on your imagination, the use of LPG can be likened to a ripening agent because it adds to the red, ripe portion from both sides. Because less motor fuel will need to be made from crude oil *less* crude oil will be used and more will be left. On the natural gas side a considerable portion will be converted to the liquid or ripe condition and less will be left as natural gas. Thus, we can go a long way toward making our big apple more digestible which, in our industrial economy, means that it will be more profitable to all concerned. This is my Big Apple Theory on the question of liquefied petroleum gas as a motor fuel.

There is one fact of great significance shown in Fig. 5 which has not been commented on in this discussion. Note that the whole basis of the LPG industry is the 6% of butane blended in motor fuel. This motor fuel use of butane first partially justified the natural gasoline industry and then in turn was the springboard from which the infant LPG of the early 1930's was launched. In the intervening years this use has helped justify a number of refinery process steps which otherwise might not have been economically feasible. No other use except military emergency has been able to make a dent in this use. As a matter of fact one of the reasons for seasonal price fluctuations for butane is that some refiners get overcommitted on butane during the summer and can afford to outbid all competition to saturate their winter motor fuels.

It has become almost an axiom in refinery operations to blend butane in motor fuel to the maximum at all times. This is so much the case that, except in one special instance, there is no such thing as a minimum vapor pressure specification for any kind of motor or aviation gasoline. If there were the remotest possibility that anyone might find it profitable to furnish a gasoline of very low vapor pressure it would become necessary to adopt minimum vapor pressure specifications, because of performance considerations. The plain, unvarnished economic fact is that this motor fuel use of LPG is by far the most profitable of any use developed to date. And when the word profitable is used it means profitable to all concerned, royalty owners, producers of oil and gas, refiners, marketers and consumers. Compared with this high value indirect method, the economic situation is entirely different for the direct use of LPG. Nevertheless, one could conclude from this salient fact in conjunction with the trends in production and potential availability that the large scale use of liquefied petroleum gas as a direct motor fuel *is* as certain as tomorrow's sunrise, and that the development will be profitable to all concerned.



DISTILLATION UNIT at the "Aquila" refinery

Reforming, LPG Recovery Units Installed in Trieste Refinery

REBUILT REFINERY of "Aquila" Societa Per Azione Tecnico-Industriale at Trieste includes thermal reforming and propane-butane recovery units

THE Italian independent organization "Aquila" Societa per Azioni Tecnico Industriale is adding to its refining facilities at Trieste a thermal reforming plant and propane-butane recovery unit. The improvements are to be completed by fall. Rated capacity of the refinery is 3000 b/d.

The decision to erect the reforming plant arose from the fact that the octane number of straight-run gasoline from Middle East crudes is only about 40-41 unleaded, while market requirements call for an octane number of at least 72, which could not be obtained by only adding lead to the gasoline at present produced. The reforming unit was designed and engineered by Universal Oil Products Co.

The following additional installations for the production of a wide range of lubricating oils are also under construction at the "Aquila" refinery: propane de-asphalting, Furfurol solvent refining, MEK dewaxing, contact filtration and a new fully automatic lubricating oil blending plant. The lube oil facilities are scheduled for completion by next March. The lube oil plant is licensed by The Texaco Development Corp. and Standard Oil Development Co. and is engineered by E. B. Badger & Sons Co.

Estimated annual production of the lubricating oil plant is about 225,000 bbls. of 95 Viscosity Index oils and bright stocks and 8,000,000 lbs. of various type paraffin waxes.

The "Aquila" Societa per Azioni Tecnico Industriale was established under Italian law in 1935 and the refinery started operations in 1937 with an annual output of about 2,700,000 bbls. It produced gasoline, solvent naphthas, white spirit, kerosine, gas oil, fuel oil, lubricating oils, asphalt, paraffin wax and, in a subsidiary factory, candles, boot polish and similar products. It was the first refinery in Europe to produce lube oils by solvent refining, using SO_2 and SO_2/benzol as solvents.

In June, 1944, the refinery was almost completely destroyed by an Allied air attack. The plant was reconstructed and operations resumed in June, 1947, in the rebuilt atmospheric and vacuum distillation plants, chemical treatment plants and ancillary installations. The refinery is now working at more than 140% of its pre-war capacity, with an average annual output of:

Product	Bbls.
Gasoline and white spirit	725,000
Kerosine and power kerosine	275,000
Gas oil	1,000,000
Fuel oil and road asphalt	2,000,000

"Aquila" was the first European refinery to receive financial aid from the Economic Cooperation Administration, $4,250,000 being provided for re-construction and modernization through installation of the reforming and C_3-C_4 splitting units. This was about half of the cost of the improvements, the remainder being supplied by the company itself.

COMPACT CONSOLE *at control room center accommodates two dial systems, large bank of alarm indicators, telephones and working space for four men*

SITTING IN CENTER OF CONTROL ROOM *the operator dials to check various operating conditions but still has complete view of entire instrument panel*

Today's dial telephone scheme has offered a solution to the growing complexity of operating the modern petroleum processing plant. It helps keep within the operator's reach and vision many critical process variables. One difficult problem which the dial idea has worked out successfully is that of temperature measurement. The scheme can be adapted to almost any other variable.

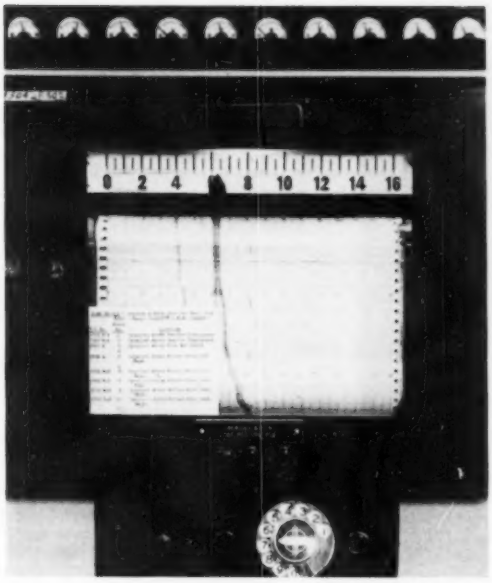
Most of the systems discussed in this article are in operation at Sun Oil Co.'s Toledo refinery. The article was presented originally as a paper by the author at the Fifth National Instrument Conference in Buffalo, Sept. 19, under the title: "Process Monitoring Systems."

Want a

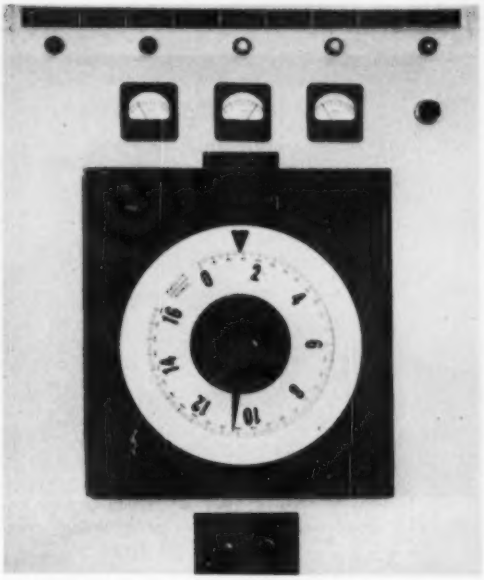
By E. J. GRACE, Jr.,
Chief Instrument Engineer
The Sun Oil Co., Philadelphia

THE increase in size of process units together with the ever mounting dependence on instrumentation to correlate all functions of these huge installations have posed many problems for the instrument engineer in recent years. One of the most exasperating of these has been the matter of measuring at a central point the miscellaneous temperatures, pressures, levels, and flows that are not critical in the operation but are of great importance to the operator or engineer in determining the optimum operating condition of various pieces of equipment such as heat exchangers, pumps, and compressors.

In the past it has been the general practice to convert the various physical measurements involved to electrical units and run wires to a central point where a multitude of



TEMPERATURE SURVEY SYSTEM employs this unit located on panel board proper. Small indicators at top show thermocouple that is connected to recording point of instrument below



CONTINUOUS SCANNING SYSTEM uses this type of panel-mounted unit. Indicators at top show thermocouple connected to self-balancing temperature indicator. Button at bottom puts scanner in operation after an alarm condition

Temperature Record—Dial It!

key switches was made available for the operator to select any particular point for measurement.

With an ever increasing number of points to measure, the space requirements for indicators and key switches became prohibitive.

For an installation of 1000 points, there is no practical method of arranging indicators and key switches that will permit an ambidextrous operator to press the switch handle and still be in a position to see the indicator. Duplication of indicators was necessary.

The problem of wiring and conduit arrangement was even more difficult —to say nothing of spares and future additions. Faced with a requirement for between 500 and 1000 indicated temperature points and a limited panel space, an investigation into the use of circuits and equipment similar to that used in telephone work was instigated.

An analysis of many process units indicated that the best system would be one where a switching unit that would accommodate 10 points could be installed near the points of measurement with short leads from the unit to the measuring devices and then a common two-wire bus picking up all the switching units and returning to the indicating instrument.

The first complete system was designed and built by the Sun Oil Co. and accommodated 400 indicating temperature points. All subsequent systems have been built by the Panellit Co.

The various systems which are described in this paper each contain 3 separate circuits; the selecting circuit which operates at 45 volts D.C., the measuring or controlling circuit, and the checking circuit.

The stepping switches have been identified by their position in the digital system and are referred to as hundreds, tens and unit switches. The measuring device is connected only to the unit switches.

Dial System

This type of circuit is relatively simple and is shown diagrammatically in Fig. 1 for a maximum of 1000 circuits. This requires the operator to dial three figures, the first two operations of the dial select a particular circuit through the switches, the final dial operation connects a measuring device to the common bus. Note that the measuring circuit is only through the last stepping switch and does not pass through the other two switches in the system.

One feature of this system permits arrangement of the thermocouples on the stepping switches in such a manner that the operator may dial the lowest point on any unit switch, such as 321, and then run through the next 9 points by adding one impulse each time.

To clear the system for the next reading, the operator must push a release button that r e s e t s all switches that have operated, to their normal open or "homed" position.

Unlike a telephone system, wrong numbers or improper dialing must be brought to the attention of the operator.

Two systems have been developed to meet this requirement:

1) The use of a resistance network with three indicating voltmeters to show the position of each digital unit — hundreds, tens, and units.

2) An electrical impulse fed back

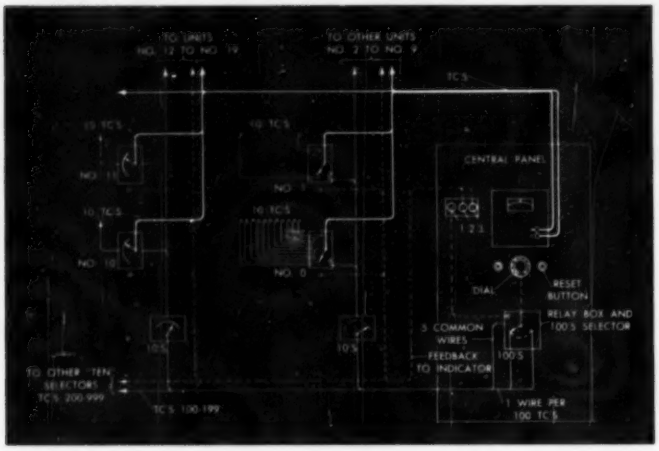


FIG. 1—Diagrammatic arrangement of a dialing system for a maximum of 1000 circuits

from a stepping switch to an identical stepping unit to which has been attached a numbered segment that indicates the number of impulses delivered to that particular stepping switch from the remotely located unit. Here again three units are to show the position of the digital unit.

The resistance system is used in those monitoring systems where the impulse is supplied mechanically, such as an automatic scanner which operates unattended. The feed back impulse is preferred in those systems where the selection is made manually, such as the dial system.

In those installations where two types of thermocouples are used, an automatic switchover circuit is used which permits the operator to view only the correct scale for the type of thermocouple that is connected in the circuit.

Basic Unit

The basic unit of the system is a 10 point stepping switch with three banks of gold plated contacts. An impulse coil drives three contact fingers. Each impulse advances the switch one point and is capable of receiving up to 30 impulses per second. A release coil allows the fingers to return to the open position through a spring drive whenever the release coil is energized. An additional contact is operated by the impulse coil armature when the impulse feed back system is used.

The stepping switches are mounted on a bakelite panel which in turn is mounted on a steel panel with the necessary terminal blocks and the entire assembly is factory wired with necessary extension leads of copper wire, depending on final service. To date these unit assemblies have been wired for chromel alumel, iron constantan, and copper constantan thermocouples and copper for pressure transducers or motor operation.

Scanning System

The scanning system is basically the same as the dial system except that the manual operation of the dial is replaced by a timed impulse occurring every few seconds. This system is shown in Fig. 2. An intermediate switching circuit is interposed to reset the various tens and unit stepping switches as the scanner proceeds through its sequence.

The total number of circuits scanned is variable between ten and eight hundred. The measured points are fed into a self-balancing indicator with alarm or control mechanisms attached which may stop the progress of the scanner until it is manually reset by the operator.

The resistance type of position indicator is used with the scanning system. At the present time one scanning system on 160 tube wall temperatures has been in operation for seven months, twenty-four hours each day without any interruption.

Continuous Indicator

The need for temperature indication on a graphical panel produced the continuous indicator. In this monitoring system a departure was made from the stepping switch with release coil to a switch with continuous circular drive, having five switch banks and twenty contacts per bank. The system is shown in Fig. 3.

Two of the switch banks connect thermocouples to a self-balancing indicator, the other three banks connect selsyn motors to a master selsyn which is positioned by the measuring drum of the indicator through a simple cam arrangement.

A motor-driven impulse timer controls two circuits, a D.C. circuit that advances the rotary stepping switch and connects a thermocouple to the self-balancing indicator, at the same time connecting a slave selsyn to the master selsyn in the indicator. A few seconds later, at which time the indicator comes to balance, A.C. power is applied to the selsyn circuit so that the slave will synchronize with the master selsyn. A.C. power is then removed and the next

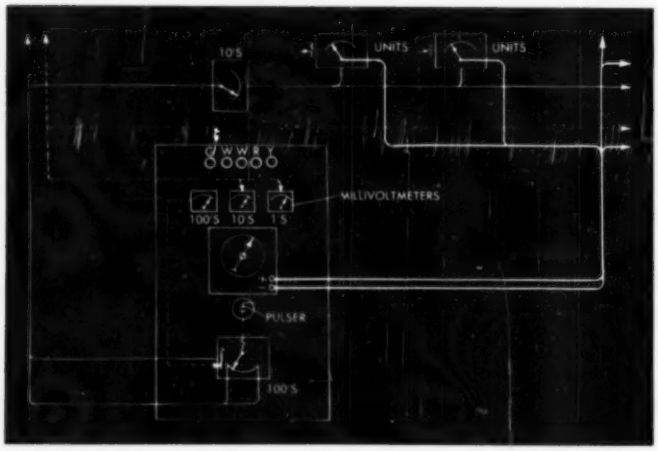


FIG. 2—Automatic scanning system in which timed impulse replaces manual operation of a dial

D.C. impulse given. Thus, one self-balancing indicator is used to continuously indicate twenty points on separate indicators. The cam drive of the master selsyn makes possible a scale expansion of the three-inch indicator in the center of the scale to the point where 5° can easily be read on a range of 500° to 1500° F.

Survey System

One process required the periodic comparison of eight temperatures in the same plane at ten different zones in a vessel and to continuously record the highest temperature in each zone.

Here the dial system was used with the variation that the output of a stepping switch was continuously connected to each point of a ten point recorder representing the ten zones; and eight thermocouples connected to the points of the stepping switch. The position of the stepping switches was indicated by the resistance method, using ten small indicators located immediately above the ten point recorder. The system is shown in Fig. 4.

With the addition of a few standard relays, any recorder point can be switched to any one of its eight thermocouples without disturbing the setting of any of the other points. At all times the arrangement of thermocouples connected to the recorder is indicated to the operator and is logged on the chart using a two digit system.

Control Point Setting

The use of a standard dial system as a means of setting the control point on remote pneumatic controllers has many interesting possibilities.

In this application selsyn motor drives are used for setting the control point in the remote controller. One master selsyn in the control room can be connected to any one of a large number of slave units and power applied to the system after the circuit has been set up.

In this case the master selsyn synchronizes with the slave driver, since the latter is operating through a gear train.

Electrical feed backs into three common buses to self-balancing indicators show the controlled variable, the control point setting and valve air pressure or position.

Remote Operation of Pumps

A system for remote selection of pumping units has long been needed to complete the instrumentation of large process units. Whenever a pumping unit has failed, it has been necessary for the operator to leave the control house and manipulate valves before a spare unit can be brought into service.

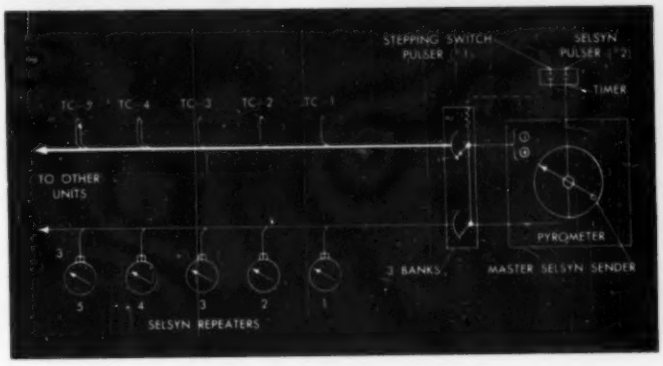


FIG. 3—Multiple continuous temperature indicator

Using the dial system, the circuit is set up for a particular pump and the starting button pushed, which initiates a modified sequence control circuit to open an electric-operated suction valve, check suction pressure, start motor or turbine, check discharge pressure and finally open an electric-operated discharge valve. All operations in this sequence are checked by a resistance system and indicated in the control room on a common indicator for all units. This indicator is fed by a common bus system, since only one unit is connected to the control and indicating circuits at any time.

The system described here is a proposal and has not yet been installed.

At the present time there are 7 dial systems in operation, 1 scanning system, 4 survey systems, and 1 continuous indicator with 16 selsyns. The total number of measured variables in all these systems exceeds 1600.

No Service Problems

There has not been one service adjustment made on any of this equipment since it was placed in operation. Some units have been in constant operation for 18 months in hazardous and corrosive atmospheres without any contact trouble.

One feature of all systems described here requires special mention. All switching is accomplished with the operating contacts carrying no load or potential.

Savings in wire, conduit, fittings, labor, and panel board space becomes appreciable in large installations of 200 points or more, using this system of local "unit" selectors.

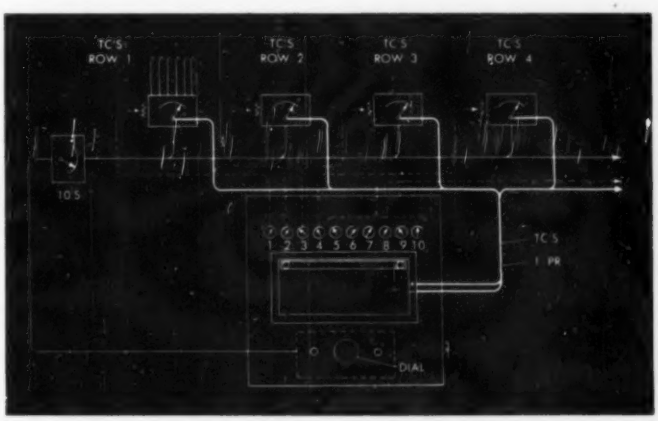


FIG. 4—Survey system which compares periodically eight temperatures in the same plane at ten different zones in a vessel, recording continuously the highest temperature in each zone

OPERATORS' QUALIFICATION TESTS *such as this position pipe test enable Esso's Baton Rouge refinery to maintain high quality welds*

The essential requirements for welding quality control in a large refinery are presented. Details are given of rigid welder qualification tests, continuous inspection of welders' work throughout their employment period, which becomes part of employe's record, and control of welding materials. Esso Standard's Baton Rouge refinery has pioneered in work in this field and its requirements are believed stiffer than those of most oil companies.

From a Report* by
A. F. BLUMER, Head,
Specification Inspection Dept.,
Esso Standard Oil Co., La. Div.,
Baton Rouge, Louisiana

How to Control Welding Quality

A LARGE petroleum and chemical refinery is a complex system of processing equipment, piping, and tankage. All of this must be maintained in safe and efficient operating condition and much of the maintenance requires welding. A large variety of welding applications is encountered. In the interest of obtaining high quality strength welds and performing welding in the most efficient and economical manner, welding quality control must be exercised.

Welding quality control consists of qualification testing of welding operators, continued sampling and welding inspection on jobs in progress, testing and selection of suitable electrodes, adherence to carefully developed welding procedures and job specifications, and and evaluation and use of applicable new developments in the field of welding.

Welding quality control unquestionably begins with the employment of the welder. Every welder employed by the refinery and every welder employed by a contractor working in the refinery is required to demonstrate his ability to satisfactorily perform welds of the quality demanded through a qualification test.

Qualification Tests

It is the endeavor in refinery welding operations to create versatility and steer away from specialists in any particular type of welding. Welders must be equally good on pipe work, vessel fabrication, and alloy welding. The only distinction made is between acetylene welders and metallic arc welders. Qualification tests for both of these types are identical except that the welds are performed by the method for which the welder is endeavoring to qualify.

Qualification tests are two-fold, consisting of a butt-welded plate test and a position pipe welding test. Fig. 1 shows the details of the specimens making up these two tests.

On the plate test, two pieces of ASTM A-285 firebox grade carbon steel ½-in. thick are butt welded together, all welding being performed from one side using AWS E-6010 electrodes.

In this test, the two pieces are tacked together and the specimen fixed in a position about head high. The elevation of the specimen may be altered at the discretion of the inspector, sometimes being as low as 24 in. above the floor. In all cases, however, the weld is an overhead weld.

The position pipe welding test consists of welding up the closed specimen shown in Fig. 1. AWS E-6010 electrodes are also used on this test. It is required that the specimen be mounted with the 4 in. run in a horizontal position with the 3-in. lateral pointed downward. The specimen is tacked together and then fixed in a location 24 in. from the floor and 8 in. from a wall and must remain so fixed until all of the welding has been performed.

During the qualification test, the quality of the welding is carefully scrutinized by an inspector and the welder's ability to weld evaluated in general terms. The plate test is cut into four strips and physical tests conducted as shown in Fig. 1, thereby evaluating the physical properties of the weld. The pipe specimen is hydrostatically pressure tested at 1600 psi. and must show no leaks.

Samples are cut from the welds, etched and closely examined. In some cases X-ray examination may be

* Condensed version of a paper given at the Petroleum Mechanical Engineering Conference, American Society of Mechanical Engineers, New Orleans, Sept. 24-28, under the title "Welding Quality Control in a Petroleum Refinery".

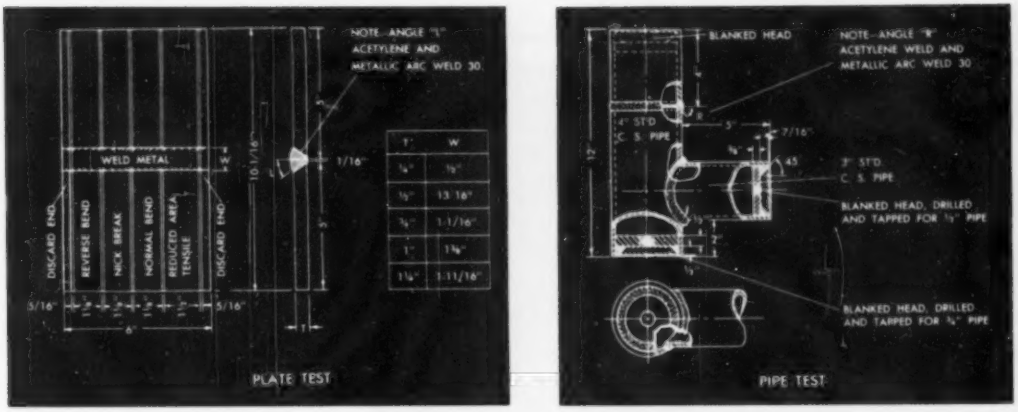


FIG. 1—STANDARD TESTS include the plate test, evaluated as indicated, and the pipe test in which the specimen is hydrostatically tested to 1600 psi.

made. A point system has been devised on such factors as general appearance, root penetration, slag inclusion, blow holes, reinforcement, and physical properties. Using this system, each welder is graded. A welder must receive 80 out of a possible 100 points in order to satisfactorily qualify.

Welding operators employed by contractors also are required to pass qualification tests before they are permitted to weld on refinery equipment. However, because of their special operations, contractor welders are permitted to qualify on either the plate test or position pipe test instead of being required to take both. In these cases, the welder may perform only the type of welds for which he took and passed qualification tests.

Where alloys are encountered, where specified electrodes are different than those normally handled, or an unusual welding procedure is required, a welder may be required to qualify using the particular electrodes, materials, and welding procedures specified for the work in question.

All welders, both refinery and contractor, who satisfactorily pass the qualification tests are assigned an identification stencil, and all welds made by a welder must be clearly marked with his stencil.

Welding Inspection

Maintenance of the high quality welding demanded in the refinery is assured through welding inspection. It has been found that one inspector can adequately cover the work performed by 20 to 30 welders when considering refinery welders. Somewhat closer inspection coverage has been found desirable for contractors' welders.

The inspectors working among the welders observe the preparation of the joints for welding, the fit up, performance of welds, and the completed welds. Where it is possible to observe a weld being performed through all of its stages up to completion, a decision is readily reached as to its suitability. Where this is not possible, representative welds are trepanned or plug samples are burned out.

Sample Regularly

An endeavor is made to take at least one plug sample from each refinery welder every three months. In most cases, samples are cut at a much greater frequency than this, especially where welding is performed on pressure equipment. In general, the number of plug samples taken is based on the footage of welding performed, this often being prescribed by some construction code or job specification.

All plug samples are cleaned, etched, and carefully evaluated. Fig. 2 shows an etched sample cut from a representative pipe weld and exemplifies the high quality of welding required. Particular attention is devoted to laying in a good root or stringer bead. It will be noted in this illustration that the root bead is extremely sound and projects inside of the pipe wall approximately ⅛-in.

In order to obtain this quality in pipe welding, continued practice led to the development of a dragging technique for pipe welding. A ⅛-in. AWS E-6010 electrode is used, with the welding machine set at normal amperage and voltage for the electrodes selected. The arc is struck and immediately the electrode is pressed deeply and firmly into the root of the joint and dragged around the pipe. In placing this bead almost all of the arc will be inside the pipe.

In straight down hand work, the electrode is dragged slowly enough

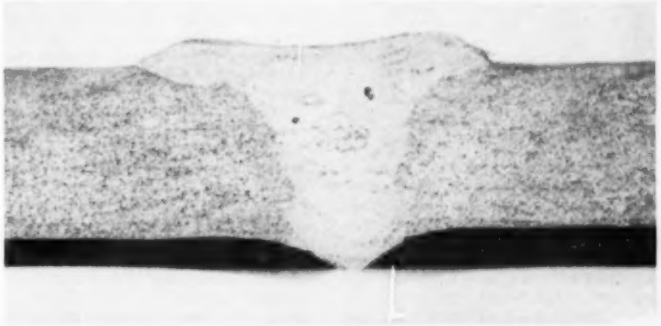


FIG. 2—HIGH QUALITY WELDS obtained are demonstrated by this etched field sample cut from a representative pipe weld

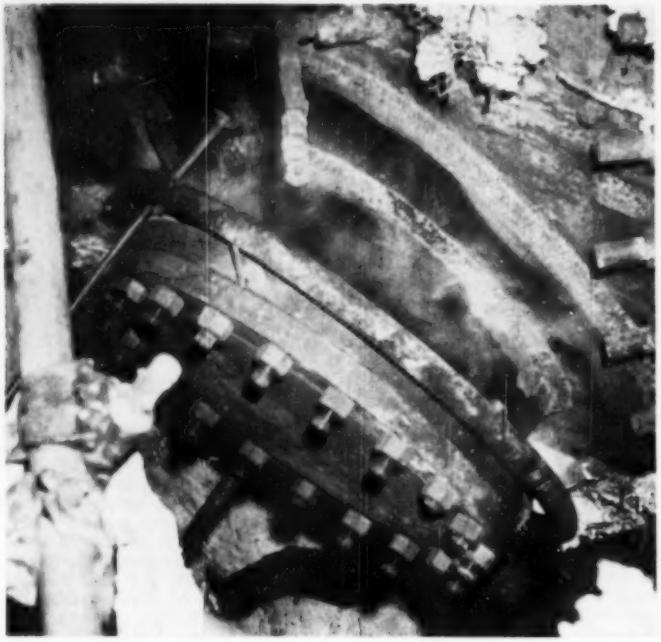


FIG. 3—STRESS-RELIEVING heavy welds, also a function of quality control, is accomplished on this 24-in. manhole with a ring-burner

to allow depositing the weld metal as it progresses. In overhead and vertical welds, essentially the same technique is used, except a series of dragging movements approximately 1-in. long, working uphill, are resorted to. After depositing the root or stringer bead, 5/32-in. or 3/16-in. electrodes are used and the weld completed. The reinforcement should project about 1/16-in. above the pipe wall and be well rounded from the edges to the middle.

Where the sample reveals bad welding, it is brought to the attention of the welding foreman, the joint cut out and rewelded. This matter also is brought to the attention of the welder who performed the weld and, in an instructive rather than critical manner, the defects are pointed out and he is advised how these may be overcome.

Close Follow-Up

When a welder performs a sub-standard weld and the matter has been brought to his attention, the work performed by this welder is closely followed thereafter until an improvement has been made in the quality of his work. This has resulted in a keen appreciation by the welders of the high quality demanded and it has become extremely rare that sub-standard welding samples are taken. It has been brought out that each welder has an identification stencil assigned to him and each weld performed by him must be prominently marked with his stencil. A welding record is maintained on each welder, both refinery and contractor, and all information pertaining to the qualification test and quality of welds obtained in welding samples is recorded thereon.

Welding Procedures

A good measure of welding quality control is obtained through the development and execution of proper welding procedures. The inspection group has experienced welders and metallurgists working in close cooperation. Often on abnormal jobs special welding procedures are developed and job specifications outlining these procedures are issued. A carefully planned operation naturally produces more successful and better quality welding than hit-or-miss welding operations conducted during the performance of the actual job. In some cases, some experimentation may be conducted to determine a suitable welding procedure, while in others it may be a job where experienced welders and trained metallurgists are able, through experience and knowledge, to work out a procedure in advance which will facilitate the welding operation.

Heavy weldments, such as illustrated in Fig. 3, are an example of this type of welding quality control. In this installation, the vessel wall is 2 in. thick, the reinforcing ring 1.5 in. thick. Prior to welding, the area surrounding the manhole was preheated with acetylene torches from 300°F to 400°F. Two welders were used on the inside and two welders on the outside.

Weld Simultaneously

The four welders began welding simultaneously, the outside welders beginning diametrically opposite on the horizontal axis and the inside welders diametrically opposite on the vertical axis. By this means, all of the welders were welding at a different point.

The weld was deposited in a cascade manner, that is, a short bead is run out, then the welder steps back and puts the second pass on the weld already deposited. He continues to step back on the deposited weld until the joint is completely filled. Using successive operations of this type, he progresses around the welded joint.

The thickness involved was such that the API-ASME Code required stress relieving. After all welding was completed, a gas burner ring was used to raise the metal temperature in the area of the attachment, and thermal stress relief was carried out in accordance with the code requirements. The burner ring permitted heating to about 1050°F. Jobs of this type usually are covered by welding procedures or job specifications.

The installation of 18-8 chrome nickel and monel vessel liners is frequently done in the refinery. Although this has become a common practice, it has been found that jobs are facilitated by preparing and issuing welding procedures or job specifications on each of the liner installations. These specifications establish whether the liner is to be plug or strip welded and specify the spacing and size of plug holes or the width of lining strips. Type and size electrodes desired are also specified.

Alloys Are Important

The use of air hardening steels, such as the straight chrome alloys, 5%, 9%, and 13% chrome; low nickel steels in cold services where impact strength at subzero temperatures is important; monel, where iron-pick up may seriously reduce corrosion resistance; and austenitic steels, such as 18-8 chrome-nickel Type 304, where intergranular corrosion may be a factor, are other ex-

amples where it has been necessary to develop specialized welding techniques and prepare job specifications.

Evaluating Welding Electrodes

Welding quality control also is exercised through the evaluation of welding electrodes. Periodically, electrodes in the AWS classifications normally used in the refinery are obtained from a large number of the manufacturers of welding electrodes. These electrodes are tested comparatively from the standpoint of general weldability, acceptability by the welders, chemical and physical properties of the deposited weld metal, amount of slag deposition and ease of its removal, and durability of the coatings both during welding and in storage. From these tests, a group of suppliers is determined who can furnish electrodes in each classification that satisfactorily meet the requirements, and purchases of the electrodes are limited to the suppliers of approved rods.

Between the periods of these large scale tests, individual tests frequently are conducted to evaluate electrodes not previously tested. Fig. 4 shows the filling of a 2 in. angle with deposited weld metal. From this deposited weld metal a 0.505 in. diameter tensile specimen will be machined and physical properties obtained. A chemical analysis of the deposited metal also will be made. During the preparation of this sample and other test pieces, the criteria previously discussed are evaluated.

Welding Research

Under welding quality control, welding research undoubtedly contributes a good measure. It is the responsibility of the inspection group, through the cooperation of the experienced welders and metallurgists in this group, to keep abreast of and investigate developments in the field of welding.

In this work perhaps notable achievement has been made in the refinery in the field of cast iron welding. Various cast iron welding techniques have been experimented with and several methods developed by which cast iron can be successfully welded by the metallic arc process.

Successful techniques have also been developed for the use of the high nickel electrodes commonly used for electric arc welding of cast iron materials. The welding of cast iron is very complex and often the welding procedures must be altered to meet the conditions. Therefore, with this type of work, several methods have been developed, some requiring preheat and others requiring no preheat, which have proved successful. Through careful study of the particular job, it is possible to select a suitable welding procedure and perform electric welding on cast iron successfully.

FIG. 4—ELECTRODE EVALUATION samples are prepared by making multiple passes in a section of 2-in. angle iron

In the handling of chemicals in the refinery, a large amount of copper or copper alloy is used. Corrosion in this equipment has necessitated welding repairs and the carbon arc procedure for welding these materials has been used successfully.

Developments such as submerged arc welding, shielded inert gas arc welding, powder cutting, oxy-arc cutting, and stud welding, and AC welding are investigated and their adaptability to refinery uses evaluated. Perhaps the most notable achievement in this field was the decision to use AC welding in the performance of certain types of welds principally involving shop work. Until this time, only DC welding machines had been used. While both AC and DC welding enjoy certain advantages and disadvantages, it has been found desirable to use both types of welding.

Conclusions

In conclusion, it should be brought out that welding is so closely related to welding quality control that it is difficult to segregate the two into distinct items. While the subject has been presented principally from the standpoint of welding quality control, the results achieved were brought about through close cooperation of the Welding Department, which supervises welding operations, and the Equipment Inspection Department, which supervises welding quality control. Through the efforts of these two groups, an extremely high quality of welding is realized and welding is accomplished in a most efficient manner.

Reiterating, the principal points of welding quality control are: 1—Selection of proper personnel through welders' qualification tests. 2—Follow-up in welding operations through welding inspection, consisting of observation of jobs in progress, sampling and evaluation of finished welds, constructive instructions to welders who perform sub-standard welding, and maintenance of welding records. 3—The development and use of suitable welding procedures, and facilitating welding operations through the preparation of job specifications. 4—The testing and evaluation of welding electrodes to compare their relative merits and to classify suppliers of acceptable electrodes. 5—Conducting welding research to evaluate welding procedures and investigating the latest developments in the field of welding for adaptability to refinery uses.

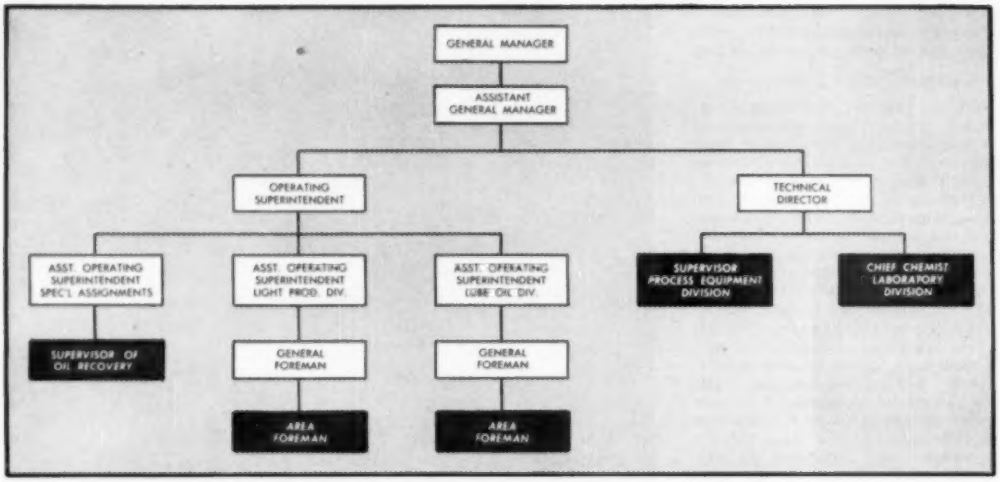


FIG. 1—Organization chart for the Paulsboro, N. J., refinery of Socony-Vacuum Oil Co. Colored areas indicate those officials who participate actively in the plant's waste disposal program

More Refiners Describe Their WASTE DISPOSAL PROGRAM

PETROLEUM PROCESSING recently surveyed a number of U. S. refineries to learn how they had organized their individual waste disposal programs. The first reports from the survey were published in the August issue, pp. 836-837. Since then, we have received a report on the practices in six refineries of Socony-Vacuum Oil Co., Inc., through E. L. Hoffman, of the company's central Production Loss Department, in New York. Data has also been supplied by the Wilmington, Cal., refinery of Richfield Oil Corp. These reports are published below.—Editor

Socony-Vacuum Oil Co.

WITH the Socony-Vacuum Oil Co., Inc., operating 10 refineries of various capacities over the country, the type of staff set up to handle the waste disposal program is determined by conditions at the individual plant. In all cases, however, the general superintendent is responsible for the efficient operation of the waste disposal system and he receives reports at least on abnormal conditions. He in turn passes on to central management information on matters affecting his plant or area which he thinks should be brought to its attention.

Frequency and type of analysis of effluents at each refinery also is determined by local conditions. Copies of routine analysis reports go to the individual in charge of waste disposal, the chief chemist and the operating superintendent. Reports showing abnormal conditions go to the refinery manager.

In each instance, one individual on the waste disposal staff is responsible for keeping himself and others informed on developments on the subject in the area but outside the plant gate. He keeps abreast of legislative matters, attends meetings of outside groups and in general serves as a liaison between local management and outside agencies which are active in any phase of waste disposal. Following are reports from six Socony-Vacuum refineries:

From Paulsboro, N. J.: 65,000-bbl. crude capacity complete refinery, including thermal and catalytic cracking.

THE refinery operating superintendent is responsible for the operation of the waste disposal system here. The setup for the waste disposal personnel is shown on the refinery organization chart, Fig.1.

The supervisor of oil recovery checks the operation of the area and final oil skimming separators. The area foremen are responsible for the operation of the separators in their area. The supervisor maintains liaison with the area foremen and reports any abnormality in operation. He also maintains close relations with the government inspectors and assists them on their periodic visits.

The supervisor of the process equipment division of the technical department directs pollution surveys. Sources of pollution located during the surveys are studied and proposals made for their abatement. The pollution surveys made at irregular intervals (currently about three times a month) also serve to check progress made in the elimination of known sources of pollution.

The chief chemist of the laboratory receives for analysis both routine samples and samples made during the pollution surveys.

Samples of the effluents from the area separators are tested weekly for oil content. Composites of daily samples of the effluents from the final separators are tested for oil content, suspended solids, total solids, methyl orange alkalinity and pH. Results of these tests are checked against the results of tests on composite samples of Delaware River water taken during the same period in order to detect any increase in contamination.

Reports of tests on separator effluents and river water are made weekly by the laboratories. They are sent to the operating superintendent, technical director, chief chemist, supervisor of oil recovery and the government district engineer for the Philadelphia district. Abnormal conditions are brought to the attention of the refinery general manager.

Results of pollution surveys are reported monthly. They cover several surveys and list all sources and nature of pollution and the effect of corrective measures. These reports are distributed to the general manager, operating superintendent and the chief engineer.

Written recommendations concerning changes in the liquid waste disposal system are made by the supervisor of oil recovery to the assistant superintendent - special assignments, who has authority to initiate the necessary work. Recommendations concerning changes in equipment or operating procedure resulting from surveys are proposed by the technical director on advice of the supervisor of the process equipment division of the technical department. These proposals are forwarded to the Operating Department for further processing.

The supervisor of the process equipment division is charged with following general pollution control: He maintains liaison with the Socony-Vacuum representative on the New Jersey Refiners Technical Advisory Committee on Air Pollution and from this source and from publications keeps abreast of developments in the field of waste disposal. Through the technical director he acquaints management with new developments in the waste disposal field.

From Trenton, Mich.: 25,000-bbls. crude capacity, thermal and catalytic cracking and reforming.

THE superintendent of refining is in charge of the waste disposal system. The API Separator System is operated by one man per shift on a 24-hour basis. The operation is supervised by the foreman and assistant foreman for blending and shipping, who report to the superintendent. In addition to his routine duties, the separator operator reports to his foreman any trouble, such as excessive oil to the separator.

Daily tests are made on composite effluent samples of oil content, turbidity and pH. Periodically, special tests are performed throughout the refinery as deemed advisable. Data from these tests is submitted to the superintendent of refining.

All suggestions for changes in the separator system are submitted to the superintendent of refining. A conference is then held with the refinery engineer and members of the process engineering department to determine the desirability of the proposed change.

A member of the process engineering department is charged with the responsibility of studying all phases of pollution control, both within and outside the refinery.

From East Chicago, Ind.: 23,000 bbls. crude capacity, thermal and catalytic cracking and reforming.

THE foreman of the water treating and light oil treating plants is in charge of the waste disposal system. One of his chief duties in this field is to coordinate the operation and maintenance of the refinery waste disposal system in such manner that pollution, or contamination of the canal into which the refinery effluent discharges will be prevented. This is accomplished through the work done by the maintenance department and by supervising the pumping department in the operation of the system. In addition he must be well informed on the latest testing methods and improvements in design and operation of waste disposal systems that are pertinent to the abatement of stream pollution.

The foreman in charge of waste disposal reports directly to the plant operating superintendent, who in turn keeps higher management acquainted with the operation of the waste disposal system and the progress in waste disposal work.

In order to determine the nature of the plant wastes, the following tests are run twice a week: pH, alkalinity, sulfate content, nitrogen bases and oil content. Twice annually, special surveys are made of the refinery effluent and the water in the canal into which it discharges. Each survey lasts for two weeks, the following tests being made daily: pH, total sulfides, phenols, biochemical oxygen demand, dissolved oxygen, suspended solids, color, nitrogen bases, oil content and turbidity. In addition, visual checking of the waste disposal system is done several times each shift, throughout the year.

Written reports of the results of the above determinations are sent to the foreman in charge of waste disposal work, the operating superintendent, chief chemist and assistant refinery manager.

When it is believed that changes in the waste disposal system are advisable, the foreman in charge proposes such improvements to the operating superintendent. If the change appears to be a practical improvement, the matter is referred to the engineering department, where preliminary plans are made. These are sent to the manager of the refinery and his assistant. If approved there, the change is made.

The foreman in charge follows general pollution control programs in the plant area. He keeps informed on outside developments by means of API conferences, publications and personal communication with other companies in the area.

From Brooklyn, N. Y.: 26,000-bbl. complete refinery, including thermal and catalytic cracking.

THE processing department here is responsible for the waste disposal and air pollution control programs, which is headed up by the assistant general process foreman. He works closely with the combustion engineer of the utilities department on all matters concerning air pollution from combustion. He reports to the general process foreman and to the refinery manager. He maintains close contact in his work with the company general refinery engineering division and also the research and development division and the technical service laboratories.

Composite samples of the effluent from the oil water separators are taken daily and the pH and oil content determined and reported daily by the technical service laboratories.

Water going to the separators includes cooling water from all refinery operations, as well as rain water drainage and all liquid waste streams. Cooling water is pulled from a sea water canal, which provides transportation, cooling water and sewage drainage for the industrial district. The refinery oil water separators discharge into this canal.

The report on the effluent water from the separators goes to the distillation, treating, shipping and receiving foreman. He is charged with routine supervision of oil water separator operation and reports to the assistant general process foreman. He also keeps the daily reports. No formal reports are made except in his general activities report. Paper work is kept to an absolute minimum. The general process foreman and his assistant inspect the records.

Unusual or emergency problems are carried up the management ladder according to their seriousness. Refinery engineering, research and

development, and technical service people are called into consultation if and as the problem warrants. Management decides on the remedy and procedure.

Air pollution prevention is confined largely to smoke abatement. Sulfur concentrations in flue gases are well below the legal requirements, from any fuel available from the low sulfur crudes charged. Here the assistant general process foreman and the combustion engineer work closely together, with significant problems going up the management ladder.

On boilers with varying loads, electronic equipment has been installed to maintain high CO_2 without smoke. Their performance is satisfactory.

Air pollution from processing operations comes first under the responsibility of the foreman directly supervising the operation and under the general supervision of the assistant general process foreman.

This individual is charged with the responsibility for keeping up with developments in pollution control and informing management concerning them. In addition, the subject is usually covered in some detail in the general manufacturing group meetings of the company which management attends.

From Atlas Works, Buffalo, N. Y.: 22,000-bbls. crude capacity complete plant, including thermal and catalytic cracking.

THE liquid waste disposal system is in charge of a foreman, who reports to the supervisor of light products who in turn is responsible to the assistant superintendent in charge of operations. Methods for disposal of gaseous wastes have not yet been formalized, but the problem is under consideration.

The chief specific duty of the foreman in charge of disposal of liquid wastes is the recovery of oil from plant wastes, with a view to maintaining an oil-free effluent. Included in the scope of this activity is the checking of any abnormal oil discharges into the plant recovery system. Acidity of incoming cooling water is also controlled. Adequate plant personnel, including a sewer inspector, is assigned to the work.

Comprehensive studies of effluents are usually made every two years, in which any changes in the nature of the wastes would be detected. These studies include analyses for every property or component known to be of significance. The studies are of the survey type, incorporating results of continuous sampling over a period of time varying from a week to a month of inlet and outlet waters, as well as process waters from individual units of the plant. Special provisions are usually made for these surveys, including technical assistance from other departments.

If material changes in the waste disposal system appear desirable, all sources within the company would be drawn on for advice, including the research laboratories, refinery engineering division and representatives on various API committees studying waste disposal matters.

The plant superintendent has assumed the responsibility for keeping in touch with any developments in the general pollution control program in the area in which the plant is situated. This is accomplished through communications from various goverment agencies, attendance at public hearings, membership in an industrial wastes association, and through advices from the company's legislative contacts.

The supervisor of the waste disposal system follows very closely the general pollution control programs sponsored by local agencies. He maintains active membership in the API Waste Disposal Committee, American Water Works Assn., Sewage Works Assn., and American Society of Civil Engineers (Industrial Group).

Constant vigilance is maintained throughout the entire waste disposal system at all times and any suggested projects designed for the improvement of existing methods for the processing and handling of liquid wastes are thoroughly explored, both in the laboratory and in pilot plants in the field. Recommendations for improvements in the system coming from the supervisor are passed on to the refinery superintendent. If approved they are then given to the engineering department to develop.

The wholehearted cooperation of the top management for the various oil companies and the teamwork of those responsible for the control of pollution, both liquid and atmospheric, has been outstanding. There is evidence that great improvements have been made and will continue to be made, since we have the full support of those now engaged in a wide field of study on what is no longer a local problem.

From Augusta, Kans.: 26,000 bbls. crude capacity, including viscosity breaking, thermal and catalytic cracking and HF alkylation.

THE utilities department is in charge of the waste disposal system. This is an operating department in charge of boiler feed water treatment and steam generation, waste water treating system, and water circulation at the cooling towers and its distribution at the various operating units. The department reports on waste disposal work to the plant manager.

Inspection of the refinery effluent is accomplished by the collection of a weekly sample, which is composited and analyzed monthly. Periodically, toxicity tests are made on gold fish, using spot samples, as well as the composite, to determine the necessary dilution.

Richfield Oil Corp.

By William Graham, Supervisor Oil Recovery and Waste Water Disposal, Richfield Oil Corp., Wilmington, Cal.

IN THE Richfield Oil Corp. Watson (Wilmington) refinery, slop oil recovery and the operation of the liquid waste disposal system are in charge of one supervisor. He is responsible for the direct handling of all liquid waste, the recovery and processing of slop oils; he directs the personnel in the skimming operations in the various gravity oil-water separators and all other operating functions contingent thereto.

Inspections and analyses of the final waste water effluents are maintained on a 24-hour schedule. The water chemist at the steam plant reports the effluent analysis to the shift foreman in the operating department every two hours. Any irregularities in the makeup of the effluent are corrected by the shift foreman. These control analyses are for pH and total dissolved sulfide sulfur content.

Composite samples of the final effluent are taken at intervals of four hours throughout the 24 hours and are analyzed by the water chemist who reports his findings to the supervisor. These analyses are for the determination of total oil, suspended solids, pH, toxicity, phenols, metallic salts, cyanides, oxygen consumed and bio-chemical oxygen demand (5 days @ 20° C.).

A daily report covers the two-hour inspections of the final waste water effluents, copies going to the refinery superintendent and general plant foreman and one copy being filed by the supervisor.

The analyses of the monthly composite samples of all refinery waters, including the final effluent, are sent to personnel directly interested in the proper control of these waters. Any irregularities are pointed out in this monthly report.

If changes in the waste disposal system are thought necessary, the problem is submitted to the process engineering department for their study and recommendation. One member of the conservation committee is responsible to management for keeping abreast of current developments and laws pertaining to atmospheric and stream pollution.

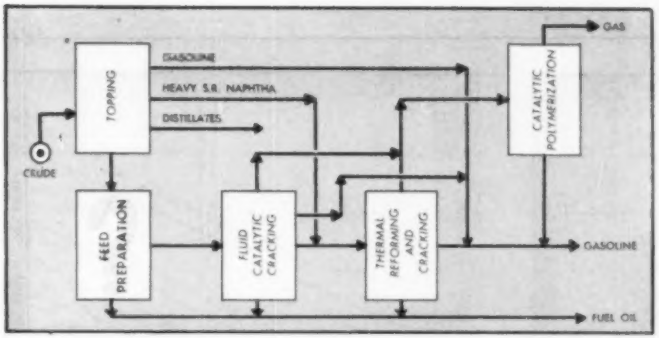


FIG. 1—Schematic flow diagram of typical refinery processing scheme

By J. W. JEWELL, Jr.
and J. P. CONNOR,
M. W. Kellogg Co., New York

Economics of Petroleum Coking For "Cat Cracking" Feed Preparation

The relative economic advantages of four conventional processes in preparing catalytic cracking feed stocks from reduced crude are presented. Incremental net earnings in each case are related to varying fuel oil values with a constant coke price, and varying coke values with a constant fuel oil price. The delayed coking process is shown to have superior earning power in a soft fuel oil market, or a good coke market.*

DELAYED coking is one of 4 conventional processes employed in petroleum refining to produce feed stock from reduced crude for catalytic cracking. Vacuum flashing, visbreaking, propane decarbonizing, and occasionally combinations of several, make up the balance of the field. It is the purpose of this paper to evaluate delayed coking relative to each of these parallel and competing processes.

Experience has demonstrated that the most valid and illuminating economic comparisons of competing petroleum processes result when the comparison is predicated upon a complete refinery operation and includes an analysis of the entire operation as opposed to commencing with an intermediate oil stream, as a feed stock, and attempting to evaluate unfinished products from the process in question. Accordingly, a typical refinery processing scheme, as illustrated in the attached schematic flow diagram, Fig. 1, has been selected as the basis for an economic comparison.

This hypothetical refinery presently includes crude topping, straight-run fractionation, combination thermal cracking and naphtha reforming, and catalytic polymerization. The problem is to add catalytic cracking and, primarily, to select the proper type of feed preparation for the catalytic cracking unit. Since we are principally interested in assaying delayed coking in this presentation, Table 1 is included in order to define the Delayed Coking process and, in general, to describe the meaning of the feed preparation step.

Principle of Coking

In principle, the coking process removes the heavy asphaltic material in reduced crude by converting it to solid coke, under controlled conditions, and in a location from which it can be removed without interrupting the continuity of the process. Included in Table 1 are typical single-pass and recycle coking yields and utility and manpower requirements for a single pass delayed coker charging 10,000 b/d of Kansas reduced crude. These items, plus maintenance, have been evaluated against a typical Midcontinent price structure in order to provide an approximate picture of the operating economics of the process itself. As a matter of interest, stream efficiencies in excess of 90% have been realized in delayed cokers for periods exceeding a year.

The competing feed preparation processes differ in that they yield a liquid bottoms stream containing the asphaltic material and produce more or less gas oil feed stock depending upon the extent of associated cracking or fractionation.

There remains to present and analyze the results of placing, successive-

* Presented before Oklahoma State Meeting, American Institute of Chemical Engineers, Tulsa, Oct. 7, 1950.

TABLE 1—Typical Delayed Coking Yields, Utilities and Direct Operating Cost

FRESH FEED:		
Stock		24.0 vol.-% Kansas Reduced Crude
Gravity, ° API		18.6
Conradson Carbon, Wt.-%		10.6
Viscosity, SUS @ 210° F.		140
YIELDS:	**Single Pass**	**Recycle**
T.P.R.	1.0	1.5
Coke, Wt.-%	18.6	24.7
Dry Gas, Wt.-%	7.6	8.5
100% C_5 Gasoline, Vol.-%	22.8	31.0
Gas Oil, Vol.-%	60.3	46.2

UTILITIES, DIRECT OPERATING COST:
(Mid-Continent area, 10,000 b/d Delayed Coker, Single Pass Operation, 24.0 Vol.-% Kansas Reduced Crude)

	Utilities	**¢/bbl.**
Labor, Supervision, Men/Shift	5-2/3*	3.5
Fuel, MM Btu./Hr.	69.2	2.5
Steam, Lbs./Hr. (average)	18,600	1.3
Cooling Water, GPM	3,480	0.4
Power, KW	250	0.6
Maintenance		2.4
Total Direct Operating Cost		10.7

* 3 men/shift, plus 4 men 16 hrs./day on decoking.

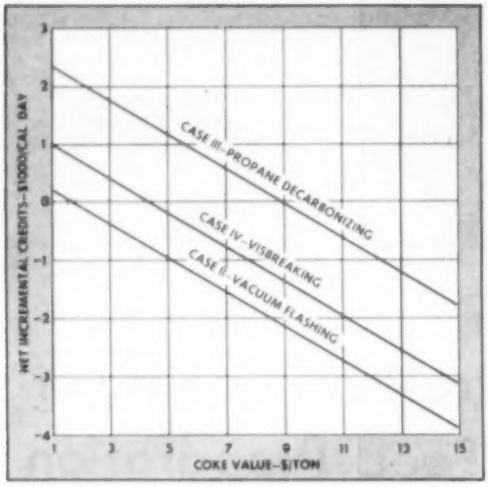


FIG. 2—Coke value vs. net incremental credits over Case I at constant fuel oil value of $1.70 bbl.

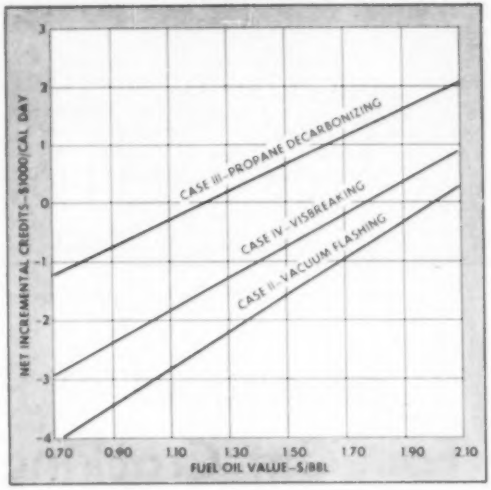


FIG. 3—Fuel oil value vs. net incremental credits over Case I at constant coke value of $5 per ton

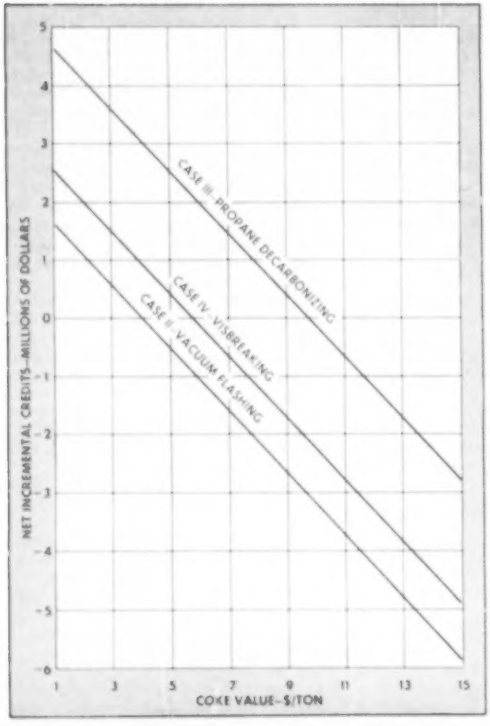


FIG. 4—Coke value vs. net incremental credit after 5 years, less incremental investment over Case I. Fuel oil constant at $1.70 bbl.

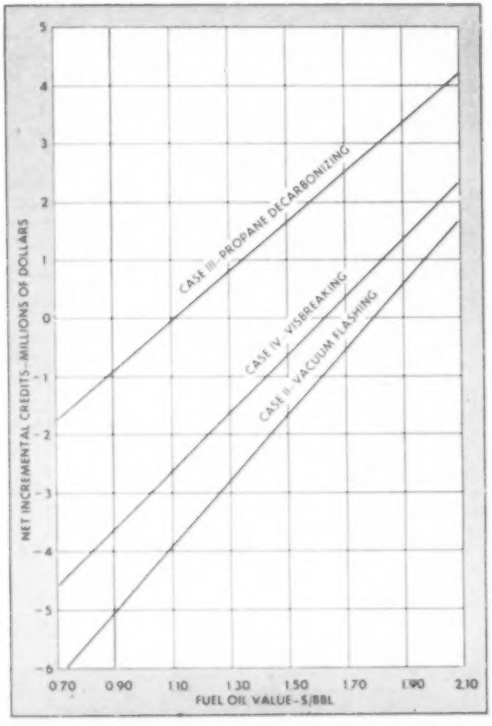


FIG. 5—Fuel oil value vs. net incremental credit after 5 years, less incremental credit over Case I. Coke value constant at $5 per ton

ly, each of the 4 feed preparation steps in the otherwise fixed processing sequence previously outlined. The conditions under which this comparison has been made are presented in Table 2. In each case the crude oil has been completely processed, (excepting product treating) in accordance with the following assumptions with respect to processing equipment.

1—Crude Topping—same in all cases.
2—Feed Preparation—same BPSD of reduced crude in all cases.
3—Fluid Catalytic Cracking—same total throughput and coke burning capacity in all cases—conversion varies with available fresh feed.
4—Thermal Cracking of Catalytic Cycle Oil—varies with the conversion on the catalytic cracker and the fuel oil cutting stock requirement. Capacity assumed available for the required range of feed stock.
5—Thermal Reforming—same operation in all cases. Octane variation is taken care of by varying TEL content of gasoline.
6—Catalytic Polymerization — capacity assumed available in each case for the polymer yield from constant per cent recovery of propanes and butanes.

Overall Economics

The overall economics have been prepared on an incremental basis away from Delayed Coking as a base. Table 2 presents an over-all economic summary of the four cases and indicates the relative economic advantages of the various feed preparation steps, both in terms of incremental net earnings and incremental net credit less the incremental investments after 5 years away from delayed coking as a base.

To illustrate the importance of the product price structure, we have prepared Figs. 2 and 3 relating incremental net earnings to varying fuel oil values when the price of coke is constant and varying coke value when the price of fuel oil is constant. The ranges of fuel oil and coke prices are representative of Mid-Continent markets over the past 5 years. Figs. 4 and 5 relate the varying price structure to the incremental net earnings of each process over a 5-year period less the incremental investment requirement.

The foregoing summaries and figures indicate, in general, that the delayed coking process enjoys superior earning power in a soft fuel oil market or a good coke market. The distinctly greater investment requirement for coking throws the indicated advantage to the less expensive processes under market conditions as represented by the basic price structure.

The validity of this type comparison depends to a large extent upon the basic assumptions surrounding the calculations. In making such an analysis for a particular refinery, it would be impossible to overlook the effect of each process upon the refinery steam and water balances, the intermediate and product tankage capacities, and the ability of the refiner to market the ranges of production encompassed in the four cases. In many cases one or more of these considerations impose limitations which dictate choice despite relative economic desirability and in any event the magnitude of the outside facilities problem is potentially great enough to completely alter the general conclusions reached in the basic analyses which we have presented.

For many years the Delayed Coking process has been regarded with disfavor by many refiners, due largely to its intermittent type of operation, its dirty and tedious coke removal and handling problems, and its relatively high investment and operating costs. On the other hand, when the supply of residual fuel oil has exceeded the demand, coking has provided the *only* complete relief from the necessity of reducing crude runs or building expensive storage capacity.

This flexibility, coupled with its high earning power in the presence of a good and stable coke market, has proved to be a profitable combination for many refiners. The quality of coker gas oil as a feed stock for catalytic cracking has been thought by many to be inferior to the product made by the other feed preparation processes. It is our opinion that, as in other feed preparation methods, the feed stock and type of operation, constitute the principal quality determining factors rather than the process itself.

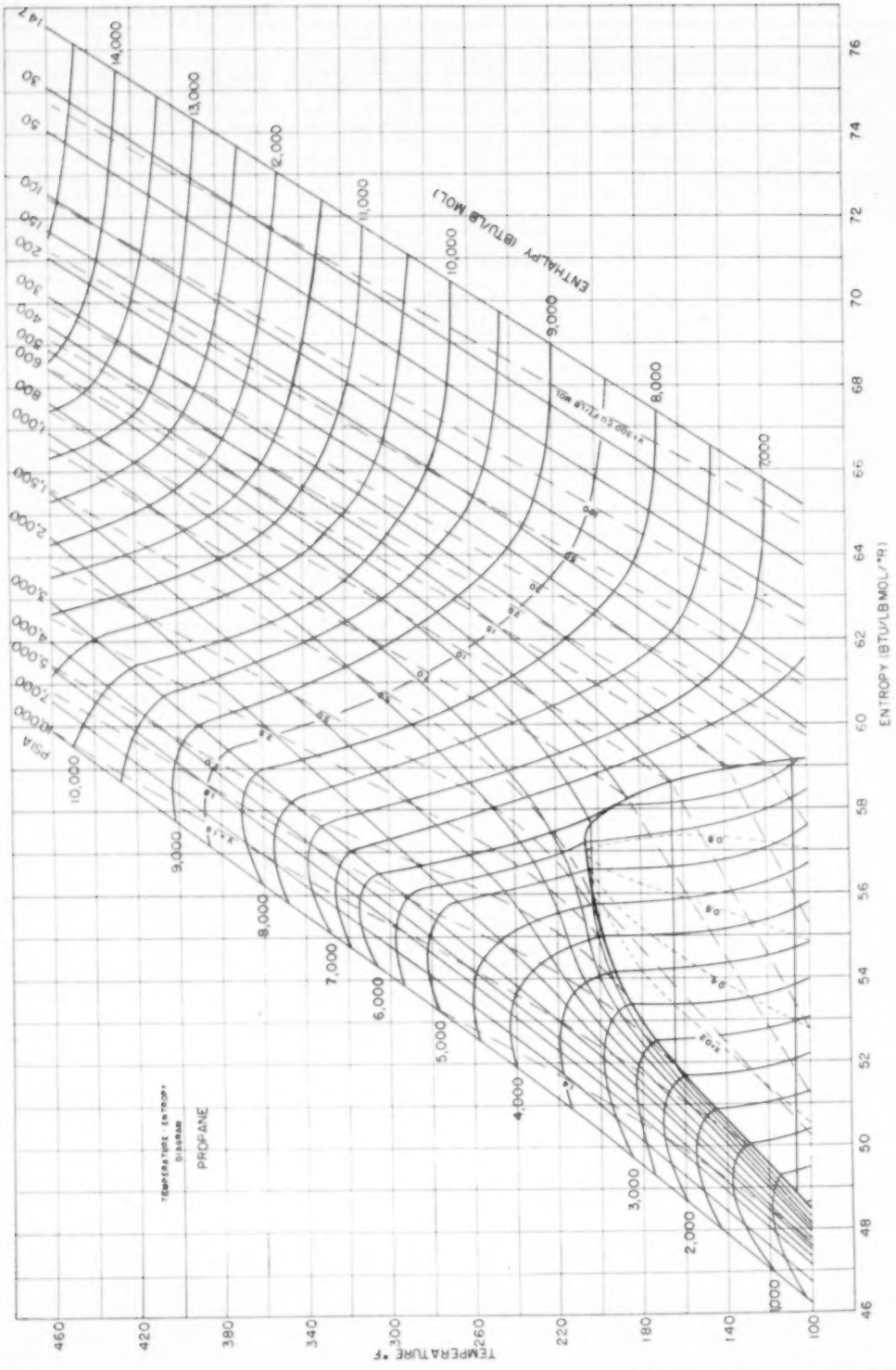
Ultimate Aim

A feed preparation process which will provide the ability for the refiner to shift at will from solid to liquid residual fuel, and yet not be dependent for its economic justification upon the market conditions of either residual product, is the aim of current development work in the field of petroleum coking. Since all of the major disadvantages of conventional delayed coking are associated with the coke removal and handling equipment, the principal efforts of development work (presently in the pilot or semi-commercial plant stages) are directed toward the simultaneous production and removal of coke in a system analogous to fluid catalytic cracking. It is anticipated that success in perfecting such a system will not only remove much of the operating prejudice against coking but also materially improve its economic attractiveness in terms of reduced capital and operating costs.

The distinct possibility of improved operating flexibility both with respect to the range of feed stocks which may be coked, and reduction of the extent of cracking associated with coking, also provide incentive for the development of a more attractive coking process. The presence of an apparently unlimited market for petroleum coke, at some price, and the probability of fuel oil continuing to be a local or periodic problem, indicate that a coking process will continue to have a place in petroleum processing for years to come.

TABLE 2—Overall Economic Summary of Four Conventional Processes for Preparing Feed Stock from Reduced Crude for Catalytic Cracking

Feed Preparation Process		CASE I Delayed Coking			CASE II Vacuum			CASE III Propane Decarb.			CASE IV Visbreaking		
Crude—BPSD		36,400			36,400			36,400			36,400		
cc TEL to 91 CFR-R (Premium)		2.0			2.0			2.0			2.0		
cc TEL to 85 CFR-R (Regular)		1.7			1.2			1.1			1.6		
Products	Unit Cost $/BBL	B/CD	Vol. % On Crude	$/CD	B/CD	Vol. % On Crude	$/CD	B/CD	Vol. % On Crude	$/CD	B/CD	Vol. % On Crude	$/CD
Premium Gasoline	4.83	4921	15.0	23768	4586	14.0	22150	4816	14.7	23261	4698	14.3	22691
Regular Gasoline	4.62	14765	45.1	68214	13792	42.1	63719	14447	44.1	66745	14093	43.0	65110
Kerosine	3.78	653	2.0	2468	653	2.0	2468	653	2.0	2468	653	2.0	2468
Range Oil	3.68	3600	11.0	13248	3600	11.0	13248	3600	11.0	13248	3600	11.0	13248
#2 Furnace Oil	3.47	2616	8.0	9078	2616	8.0	9078	2616	8.0	9078	2616	8.0	9078
Fuel Oil	1.70	1965	6.0	3341	5078	15.5	8633	4324	13.2	7350	4721	14.4	8026
Fuel Gas (F.O.E.)	1.90	2943	9.0	2649	2293	7.0	2064	2359	7.2	2123	2332	7.1	2099
Coke/Ton	5.00	294 ST/CD	6.2 Wt. %	1474	....	....	....	....	....	....	....	....	....
Total Credit				124240			121360			124273			122720
Incremental Credit above Case 1				.....			—2880			33			—1520
Incremental Debits over Case 1				.....			—1930			—1104			—1345
Net Incremental Credits Over Case 1				.....			— 950			1137			— 175
Incremental Investment over Case 1—$							—1,250,000			—500,000			—750,000
Incremental Credit After 5 Years Less Incremental Investment—$							—483,000			2,570,000			430,000


TEMPERATURE-ENTROPY DIAGRAM
PROPANE
TEMPERATURE °F
ENTROPY (BTU/LB MOL/°R)
ENTHALPY (BTU/LB MOL)
PSIA

Thermodynamic Properties of Propane

Thermodynamic properties of propane have been calculated from the recent experimental data with the rigorous thermodynamic relations. Enthalpies, entropies and specific volumes at different temperatures and pressures in the vapor, liquid and two phases regions are presented in a temperature-entropy diagram to facilitate the design calculation of the manufacturing facilities and the prediction of the actual performance of the propane plant. The range covered in the diagram, which represents the conditions of industrial interest, is from 100 to 460° F., and from 14.7 to 10,000 psia.

By JU CHIN CHU, NORMAN F. MUELLER, R. M. BUSCHE and A. S. JENNINGS*

THE increasing use of propane justifies the evaluation of its basic thermodynamic properties, and their presentation in the form of a network, such as Mollier diagram, *T-S* plot, etc., to facilitate their application in refrigeration, fuel engineering, solvent extraction and process industries.

Dana, Jenkins, Burdick and Timm[3] presented experimental data on the vapor pressures and densities of saturated liquid and vapor, specific heat of saturated liquid, and heat of vaporization of propane covering a range adequate for calculations on condensers and evaporators of compression and refrigeration units. As the superheated vapor region was not included, it is inapplicable to the compression calculations for the refrigeration cycle.

Sage and Lacey[12] presented a *T-S* chart for propane, the scale of which was small with the upper temperature at 220° F. and a reference temperature at 60° F.

Laverty and Edmister[5, 6] prepared the Mollier diagram for propane for the use in making refrigeration calculation. The reference temperature of saturated liquid was changed to −200° F. and better heat capacity data were used. It was prepared by the approximate method using generalized correlations.

Stearns and George[14] later published a more complete and accurate thermodynamic properties of propane. However, the best *P-V-T* data and equation of state available were not used.

Using the generalized correlation, Hanson[6] calculated the thermodynamic properties of saturated liquids and vapors of propane.

In Germany, Plank and co-workers[10] prepared a Mollier diagram for propane suitable for refrigeration calculation, the upper limit of pressure being 18 atmospheres.

The present work was to compile all up-to-date physical properties from which five thermodynamic properties (temperature, pressure, specific volume, enthalpy and entropy) were calculated. To facilitate its application to the design calculation in the process industries, as well as refrigeration, a *T-S* diagram was constructed.

The procedures employed in the construction of the thermodynamic diagram in the present work, the *T-S* chart on the facing page, have been well discussed.[4, 5, 7] Since extensive data have been available, the rigorous method, as illustrated later, was employed for the construction. The temperature of the chart ranges from 100° F. to 460° F., and the upper limit of pressure is 10,000 psia. The datum temperature for entropy is 0° R. at zero pressure.

Calculating Entropies

The entropies of the saturated vapor in the ideal gas state from 100° F. to the critical temperature at every 20° F. are calculated by the equation:

$$S_{SG}^{*} = S_{537}^{*} + \int_{537}^{T} Cp^{*}\, d\ln T - \frac{1.987}{44.1} \ln \frac{P_s}{P_{537}} \qquad (1)$$

The absolute value of entropy at 537° R., S_{537}^{*}, in the ideal gas state, C_p^{*}, as a function of temperature, were obtained from API Project 44.[9] The vapor pressure data of Sage and Lacey[13] were used in substituting the vapor pressure term, P_s, at different temperatures. The measurements of Beattie et al[1, 2] represent the most careful work. However, the average deviation between these two works is well within 0.5%, which will make practically no difference in engineering applications. The scales of the thermodynamic diagram are not in sufficient detail to warrant the proper choice of the experimental data reported by two different laboratories.

The entropies of real saturated vapor are related to that of ideal gas by the equation:

$$S_{SG} = S_{SG}^{*} - \int_{0}^{P} \left[\frac{R}{P} - \left(\frac{\partial V}{\partial T} \right)_P \right] dP \qquad (2)$$

Since the plot of volume, v, versus temperature along the path of constant pressure does not appear to be particularly smooth, the technique of residual volume is employed for the evaluation of the integral in Equation 2, giving:

$$S_{SG} = S_{SG}^{*} - \int_{0}^{P} \left(\frac{\partial a}{\partial T} \right)_P dP \qquad (3)$$

where a is the residual volume defined as follows:

$$a = \frac{RT}{P} - V \qquad (4)$$

The residual volumes at different temperatures and pressures are calculated by the recent *P-V-T* data of Sage and Lacey,[12, 13] the average deviation of which from the more accurate data of Beattie et al is well within 0.5%, a precision much higher than the scales of the present chart. The integral in Equation 3 is evaluated by graphical differentiation of the residue volume with respect to temperature at constant pressure, followed by graphical integration of the partial derivative, $(\partial a/\partial T)_P$, from zero pressure to the given pressure.

From the entropy values of ideal saturated vapor, the entropies of the ideal superheated vapor at different pressures along each isothermal path are calculated by the following equation:

$$S_G = S_{SG}^{*} - \frac{1.987}{44.1} \ln \frac{P}{P_S} \qquad (5)$$

The maximum pressure to which the calculations are made is 10,000 psia. The entropies of real vapor are then calculated from those of ideal vapor by the equation similar to Equation 2 for saturated vapor.

The entropies of saturated liquids at different temperatures are computed from those of saturated vapor, S_{SG}, by the equation:

$$S_{SL} = S_{SG} - \frac{\lambda}{T} \qquad (6)$$

where λ is heat of vaporization at temperature T, and its experimental data[11] were used. In the two-phases region, the values of entropy at different quality X are calculated by

$$S_X = XS_{SG} + (1 - X)S_{SL} \qquad (7)$$

The entropies of the compressed

* This paper is based on a report submitted by Messrs. Mueller, Busche and Jennings in their partial fulfillment of the requirement for a graduate course in chemical engineering thermodynamics conducted by J. C. Chu at Washington University, St. Louis, Mo., in 1949. Dr. Chu is now Associate Professor of Chemical Engineering at Polytechnic Institute of Brooklyn, Brooklyn, N. Y.; Mr. Mueller an Instructor at Washington University; Mr. Busche a Chemical Engineer with the Bureau of Mines, Louisiana, Mo.; and Mr. Jennings a Research Fellow at Washington University.

Table of Thermodynamic Properties of Propane

Temp., °F.	Pressure, Psia.	Volume, cu.ft./lb.	Entropy, Btu./lb.	Enthalpy, Btu./lb.
VAPOR PHASE				
100	14.7	404	65.20	6,610
	30	196	63.15	6,600
	50	115	62.74	6,580
	100	53.7	61.15	6,370
	150	33.2	59.89	6,090
	185	28.2	59.15	5,940
140	14.7	432	66.44	7,430
	30	210	64.92	7,400
	50	124	63.98	7,360
	100	59.3	62.45	7,200
	150	37.8	61.31	6,960
	200	26.4	60.45	6,650
	300	14.7	59.09	5,950
180	14.7	464	67.73	8,200
	30	225	66.28	8,180
	50	133	65.27	8,110
	100	64.3	63.75	7,960
	150	41.5	67.59	7,800
	200	29.8	61.87	7,610
	300	17.7	60.59	7,210
	400	11.3	59.36	6,640
	475	9.5	58.36	6,100
220	14.7	492	69.00	9,010
	30	239	67.55	8,990
	50	142	66.54	8,950
	100	69.0	65.04	8,820
	150	44.7	64.15	8,680
	200	32.4	63.44	8,500
	300	20.0	62.28	8,170
	400	13.7	61.28	7,820
	500	9.60	60.24	7,430
	600	6.68	59.04	6,890
	800	2.27	56.21	5,850
	1,000	2.03	55.63	4,520
	1,500	1.81	54.23	3,686
	2,000	1.71	53.58	3,630
	3,000	1.60	53.01	3,550
	4,000	1.53	52.60	3,520
	5,000	1.48	52.29	3,510
	7,000	1.41	51.83	3,540
	10,000	1.34	51.14	3,620
300	14.7	551	71.53	10,800
	30	268	70.08	10,750
	50	160	69.07	10,690
	100	78.2	67.56	10,580
	150	51.2	66.71	10,470
	200	36.4	66.05	10,380
	300	24.1	65.05	10,160
	400	16.4	64.27	9,940
	500	13.0	63.58	9,650
	600	10.2	62.95	9,440
	800	6.76	61.73	8,940
	1,000	4.49	60.51	8,410
	1,500	2.47	58.68	7,320
	2,000	2.07	57.30	6,490
	3,000	1.84	56.27	5,320
	4,000	1.71	55.74	5,630
	5,000	1.62	55.36	5,570
	7,000	1.51	54.79	5,590
	10,000	1.42	54.10	5,700
380	14.7	612	74.05	12,750
	30	298	72.60	12,700
	50	178	71.59	12,660
	100	87.5	70.08	12,530
	150	57.7	69.23	12,470
	200	42.7	68.59	12,360
	300	27.6	67.62	12,280
	400	20.5	66.88	12,080
	500	15.6	66.27	11,910
	600	12.6	65.74	11,750
	800	8.85	64.81	11,360
	1,000	6.60	63.98	11,000
	1,500	3.88	62.22	10,140
	2,000	3.02	61.01	9,375
	3,000	2.12	59.60	8,630
	4,000	1.92	58.83	8,350
	5,000	1.79	58.35	8,210
380	7,000	1.63	57.67	8,300
	10,000	1.50	56.94	8,380
460	14.7	670	76.54	....
	30	327	75.09	....
	50	193	74.08	....
	100	105	72.57	....
	150	63.8	71.72	....
	200	47.5	71.08	14,430
	300	31.0	70.14	14,290
	400	22.8	69.43	14,170
	500	11.9	68.87	14,050
	600	14.62	68.41	13,920
	800	10.55	67.63	13,580
	1,000	8.10	66.92	13,270
	1,500	4.90	65.52	12,600
	2,000	3.63	64.48	12,420
	3,000	2.70	62.96	11,190
	4,000	2.20	61.97	10,725
	5,000	1.98	61.37	10,540
	7,000	1.76	60.58	10,375
	10,000	1.59	59.86	10,250
LIQUID PHASE				
100	200	1.49	48.47	—50
	400	1.48	48.32	—40
	600	1.47	48.15	....
	1,000	1.44	47.95	....
	1,500	1.42	47.76	....
	2,000	1.39	47.59	....
	3,000	1.38	47.50	....
	4,000	1.33	47.33	....
	5,000	1.31	47.15	....
	7,000	1.27	46.74	....
	10,000	1.23	46.23	....
140	400	1.63	50.50	1,250
	600	1.60	50.36	1,260
	1,000	1.55	50.04	1,200
	1,500	1.51	49.80	1,140
	2,000	1.48	49.56	1,100
	3,000	1.42	49.40	1,100
	4,000	1.39	49.14	1,100
	5,000	1.36	48.91	1,010
	7,000	1.31	48.43	1,210
	10,000	1.26	47.88	1,530
180	600	1.85	52.70	2,670
	1,000	1.71	52.19	2,600
	1,500	1.63	51.84	2,500
	2,000	1.58	51.49	2,430
	3,000	1.50	51.31	2,390
	4,000	1.45	50.93	2,400
	5,000	1.42	50.66	2,430
	7,000	1.36	50.13	2,550
	10,000	1.30	49.54	2,750
SATURATED VAPOR				
104.6	200	24.3	59.13	6,030
124.4	250	19.3	59.10	6,060
138.0	300	15.9	58.90	6,110
151.6	3.0	12.5	58.75	6,120
163.9	400	10.0	58.63	6,130
175.2	450	8.4	58.44	6,120
185.2	500	7.0	58.25	6,070
194.8	550	6.5	58.00	6,000
203.4	600	5.9	57.62	5,880
206.3	617.4	5.7	57.38	5,690
SATURATED LIQUID				
104.6	200	1.54	48.87	220
124.4	250	1.59	49.75	820
138.0	300	1.68	50.51	1,310
151.6	350	1.75	51.32	1,790
163.9	400	1.82	52.00	2,290
175.2	450	1.91	52.75	2,880
185.2	500	1.98	53.51	3,070
194.8	550	2.42	54.50	3,710
203.4	600	5.1	56.00	4,650
206.3	617.4	5.8	57.38	5,690

liquid are calculated from those of saturated liquid along each isothermal path by:

$$S_{PL} = S_{SL} - \int_{P_T}^{P} \left(\frac{\partial V}{\partial T} \right)_P dP \qquad (8)$$

The experimental *P-V-T* data[12, 13] in the liquid region are used to evaluate the integral in Equation 8 by the graphical differentiation and integration.

Calculating Enthalpies

The enthalpies of propane in the ideal gas state are tabulated[9] as its heat of formation at 0° R., $(\Delta H_f^\circ)_0$, and the increase of its enthalpy above 0° R. at different temperatures, $(H_T^\circ - H_0^\circ)$. $(\Delta H_f^\circ)_0$ is the heat of formation of propane at 0° R. relative to carbon and hydrogen at 0° R. and is equal to 794 Btu./lb. The enthalpy of propane in ideal gas state at a temperature T is represented by:

$$H_T^\circ = (\Delta H_f^\circ)_0 + (H_T^\circ - H_0^\circ)$$
$$= 794 + (H_T^\circ - H_0^\circ) \qquad (9)$$

Values of H_T° are first calculated by Equation 9 with the values of $(H_T^\circ - H_0^\circ)$ at several tabulated temperatures.[9] A smooth curve resulting from the plot of H_T° versus temperatures is then used to interpolate the enthalpy data at the intermediate temperatures.

The enthalpies of real vapor in the saturated as well as superheated regions are calculated from those of ideal vapor at the same temperature by similar technique of residue volume. The working equation involved is

$$(H^\circ - H)_T = \int_0^P \left[\alpha - T \left(\frac{\partial \alpha}{\partial T} \right)_P \right] dP \qquad (10)$$

The enthalpies of the saturated liquid are obtained by subtracting heat of vaporization from the enthalpies of saturated vapors. The enthalpies of the compressed liquid along each isothermal path are then calculated from those of saturated liquids, by the equation:

$$H_{PL} = H_{SL} \int_{P_E}^{P} \left[V - T \left(\frac{\partial V}{\partial T} \right)_P \right] dP \qquad (11)$$

The values of enthalpies, entropies and specific volume in liquid, vapor and two-phases regions, were presented in the table, and the temperature-entropy chart with specific volume, pressure and enthalpy as parameters was drawn.

Nomenclature

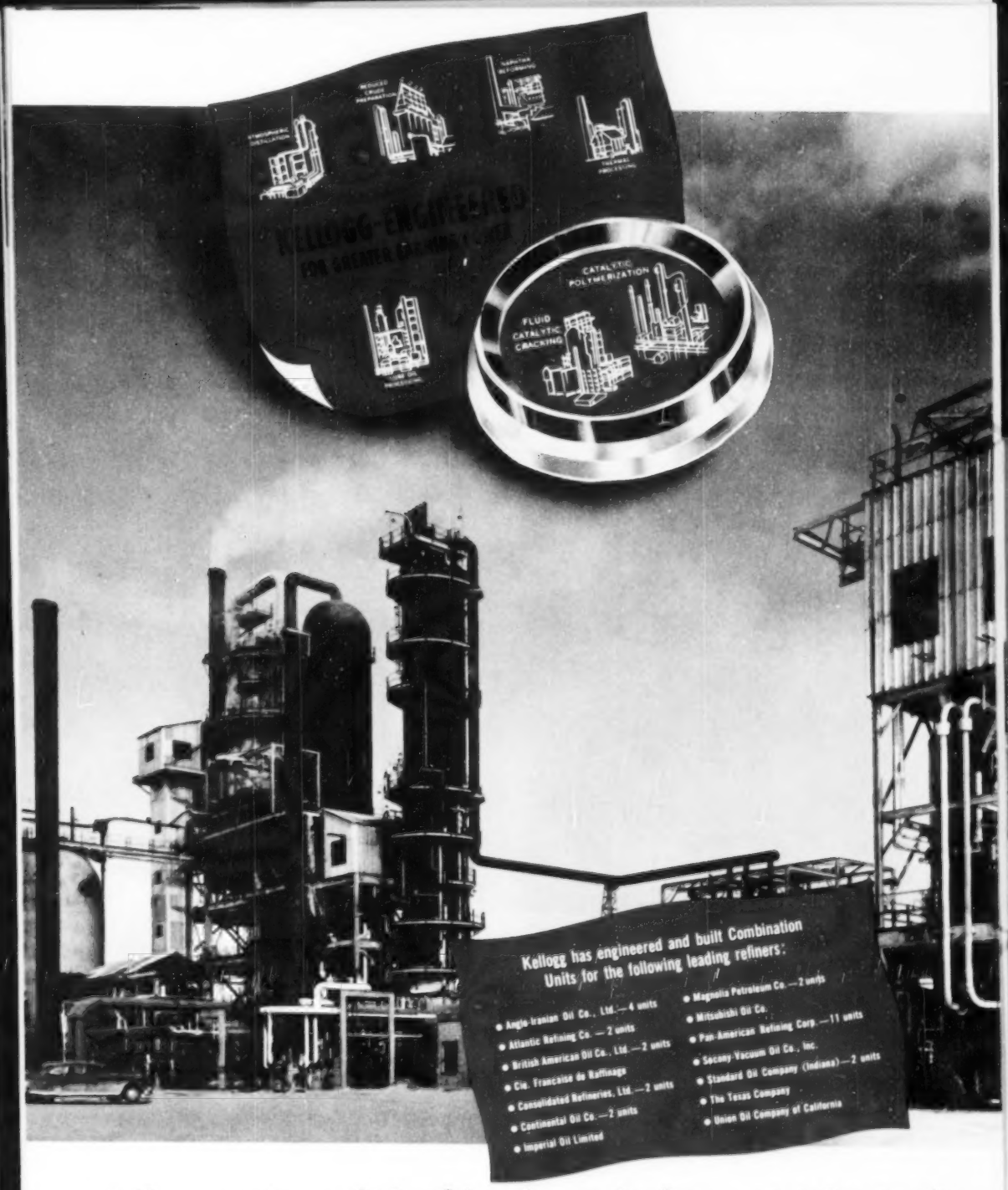
Cp = heat capacity at constant pressure, Btu./(lb.) (°F.).
H = enthalpy, Btu./lb., with reference to elements at 0° R.
P = pressure, lbs./sq.in.
R = gas constant, 1.987 Btu./(°R.) (lb.mole).
S = entropy in absolute scale, Btu./(lb.) (lb.mole).
T = temperature, °R.
V = specific volume, cu.ft./lb.
X = quality of vapor.
λ = heat of vaporization, Btu./lb.
α = relative volatility

Subscripts and Superscripts

$^\circ$ = ideal gas state
$_G$ = gaseous state
$_0$ = absolute zero temperature
$_{PL}$ = compressed liquid
$_S$ = saturation
$_{SV}$ = saturated vapor
$_{SL}$ = saturated liquid
$_X$ = at quality X

References

(1) Beattie, Kay, and Kaminsky, *J. Am. Chem. Soc.*, 59, 1589 (1937).
(2) Beattie, Poffenberger and Hadlock, *J. Chem. Phys.*, 3, 96 (1935).
(3) Dana, L. I. Jenkins, A. C., Burdick, J. N., and Timm, R. C. *Refrigerating Engineering*, 12, 409 (1926).
(4) Dodge, B. F., "Chemical Engineering Thermodynamics," McGraw Hill Book Co., New York (1949).
(5) Edmister, W. C., *Petroleum Refiner*, 28, 139 (1949).
(6) Hanson, G. H., *Trans. Am. Inst. Chem. Engr.* 42, 959 (1946).
(7) Hovgen, O. A. and Watson, K. M., "Thermodynamics," John Wiley & Sons, New York (1947).
(8) Laverty, F. W. and Edmister, W. C., *Oil & Gas Journal*, 35 (Dec. 4, 1941).
(9) National Bureau of Standards, API Project 44 (1947).
(10) Plank, R. and Kambeitz, J., Kaltechnisches Institut, Germany.
(11) Sage, B. H., Evans, H. D. and Lacey, W. N., *Ind. Eng. Chem.*, 31, 763 (1939).
(12) Sage, B. H. and Lacey, W. N., *Petroleum World* (Dec., 1934).
(13) Sage, B. H. and Lacey, W. N., *Ind. Eng. Chem.*, 41, 482 (1949).
(14) Stearns, W. V. and George, E. J., *Ind. Eng. Chem.*, 35, 602 (1943); 38, 1322 (1946).


CATALYTIC POLYMERIZATION
FLUID CATALYTIC CRACKING
Kellogg has engineered and built Combination Units for the following leading refiners:
• Anglo-Iranian Oil Co., Ltd.—4 units
• Atlantic Refining Co.—2 units
• British American Oil Co., Ltd.—2 units
• Cie. Francaise de Raffinage
• Consolidated Refineries, Ltd.—2 units
• Continental Oil Co.—2 units
• Imperial Oil Limited
• Magnolia Petroleum Co.—2 units
• Mitsubishi Oil Co.
• Pan-American Refining Corp.—11 units
• Socony-Vacuum Oil Co., Inc.
• Standard Oil Company (Indiana)—2 units
• The Texas Company
• Union Oil Company of California

Kellogg-engineered Combination units have a total capacity of more than a half-million barrels per day!

Yes! Exclusive of lube oil facilities, Kellogg has engineered major refinery Combination units with a total capacity greater than 500,000 BPD...with more capacity building!

IN this type of processing Kellogg engineers have led the way since the early '30's when they designed the first topping-cracking combination. In the ensuing years, various economical combinations have been built, including distillation, cracking and reforming; distillation and delayed coking; and most recently, distillation and deasphalting in one combination, with another Fluid catalytic cracker-cat poly combination (pictured on reverse side) as a second step.

Common advantages are elimination of intermediate storage, reduction in heat requirements, simplified piping and pumping layouts, and of course easier operation from a common control room. While flexibility is compromised to some extent, refiners facing heavy competition can well afford to look closely at the lower initial cost and lower operating costs inherent in combination processing. The experience gained by Kellogg is unduplicated both in total capacity built and in diversity of types engineered.

COORDINATED, INTEGRATED ENGINEERING IS KEY!

Engineering a true combination unit is not just a case of connecting together two or more individual process units, with instruments in a common location. Rather, it is the integrated engineering of these units into one processing whole. Albeit flexibility to vary individual unit throughputs and yields must be built in, the combination unit, in general, must be designed so that each processing step is exactly balanced with its predecessor.

Only a large engineering organization can put the necessary number of individual specialists to work as a coordinated team on such a project. Only a completely integrated organization is conditioned to the "give and take" that must be achieved between several individual engineering specialists in order to create a completely successful combination unit. (*Illustrated*—south side of the entire floor devoted to piping engineering at Kellogg headquarters).

IT TAKES ALL SEVEN TO PRODUCE GREATER EARNING POWER...

1 THE DEVELOPMENT "TOOLS"
—laboratories, pilot plants and recognized specialists to prove and improve processing and equipment ideas.

2 PROCESS ENGINEERING
by three distinct groups of specialists—*sequence* engineers, *unit* engineers and *development* engineers—supported by an extensive reservoir of exclusive data.

3 SPECIALISTS IN EVERY PHASE
of design engineering due to the completeness of Kellogg's engineering staff.

4 SPECIALIZED BUYERS
backed by the cumulative buying power of the largest company in the business.

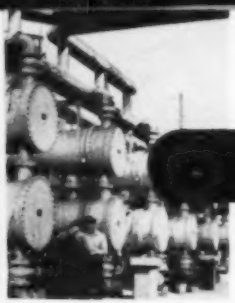
5 COMPLETE FABRICATING FACILITIES
to make schedule deadlines and to develop workable "hrsts" in refinery equipment.

6. CONSTRUCTION KNOW-HOW
acquired in completing hundreds of major jobs plus a more important factor . . . constant and close integration with the design engineering staff. This day-by-day liaison begins when the first pencil is put to paper by a design engineer. Further, it starts at the same time with the Schedules Engineer as well, continuing as each piece of equipment and each length of pipe is ordered. Thus, when Kellogg construction engineers take the field, they not only know from the plans what they are about to undertake, but the field construction methods (down even to guy derrick lifts) and timetable have all been agreed upon in detail *in advance*.

7 PRACTICAL OPERATING COUNSEL
on all design and construction, achieved through practical operating men working as an integral part of the company.

. . . AND ONLY KELLOGG HAS ALL SEVEN!

The M. W. Kellogg Company, (a subsidiary of Pullman Incorporated), New York, Jersey City, Los Angeles, Tulsa, Houston, Toronto, London, Paris [4511062]



Thermocouple Junctions Are Improved By Arc Welding in Inert Atmosphere

By A. J. FRANCESCAN and E. A. NITZ
The Texas Co., Lockport, Ill.

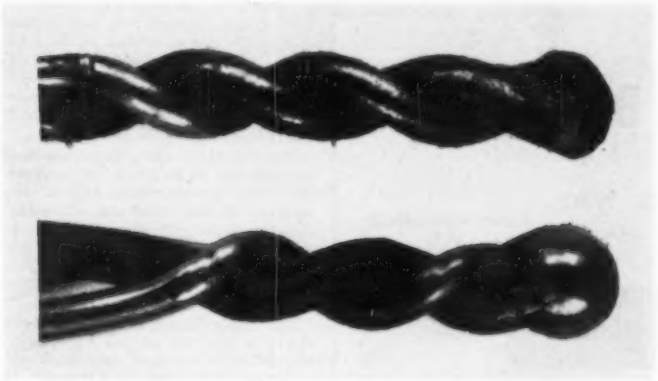


FIG. 1—CONTRAST in thermocouple weld beads as produced by improved welding apparatus: above, bead formed by old method; below, bead formed by new method

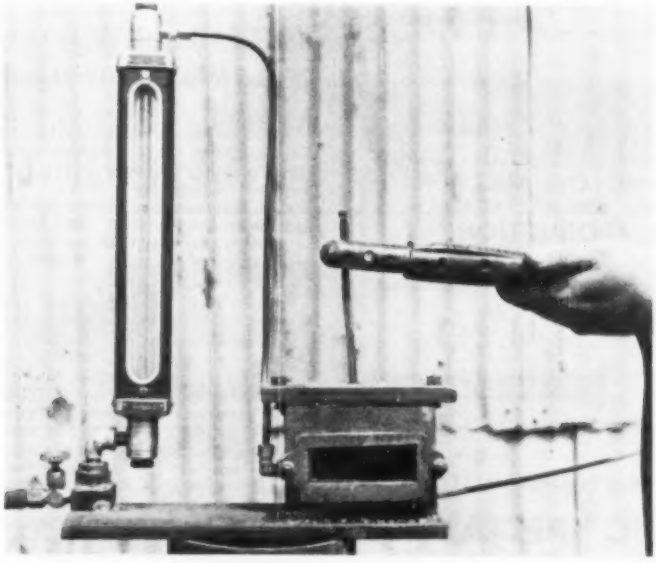


FIG. 2—Equipment devised and used by Texaco for welding thermocouple junctions at Lockport, Ill., refinery

IN THE past it has been the practice at The Texas Co.'s Lockport Works to weld thermocouple junctions in an air atmosphere using a DC welding machine. One terminal of the welding machine is connected to the ground plate and the other terminal is connected to the thermocouple wires which are to be welded. The thermocouple junction then is brought into contact with the ground plate, which causes it to become heated. After the junction is sufficiently hot, it is dipped in welding flux and then brought back into contact with the ground plate, pulled back just enough to create a hot arc between the tip of the junction and the ground plate, and held in this position until welding of the junction is completed.

Although flux is used before the welding operation is started, it has been found that some oxidation of the junction occurs during welding. The weld bead is not very homogeneous or smooth and it contains pin holes, gas pockets, and cavities. The photograph in Fig. 1 shows a thermocouple junction welded by this method (upper sample), and a similar junction welded by the new equipment devised in the Lockport shops (lower sample). This new apparatus is described in the following paragraphs and is shown in the photograph in Fig. 2. Particular difficulties, as outlined above, have been experienced when welding thermocouple junctions of small gauge wires. These difficulties decrease proportionately when larger gauge wires are welded.

Fig. 2 shows the equipment now used for welding all thermocouple junctions, composed mainly of wire sizes that range from #8 to #22. A supply of inert gas (argon) enters the ¼-in. brass needle valve, below and left of the flow meter, at a pressure of approximately 2 to 3 psig. Pressure is adjusted at a pressure regulator on an argon gas storage cylinder (not shown in Fig. 2). The ¼-in. needle valve is adjusted as needed to keep a positive pressure of the argon gas at all times in the welding chamber.

A flow meter connected in the gas supply line between the needle valve and the welding chamber indicates the presence of a positive pressure

in the chamber. The proper setting of the needle valve and the correct position of the indicator in the flow meter is gained through experience and will depend upon local operating conditions and the operator using the equipment.

The source of welding current is derived from a suitable 200 amp. welding machine. It may be necessary to install a variable rheostat in series with the existing voltage control rheostat on the machine to allow for the reduction of welding voltage output to that which is needed for handling small gauge wires. The positive terminal of the machine is connected to the welding chamber and the negative terminal is connected to the thermocouple wires (using a regular electrode holder as shown in Fig. 2).

The control rheostat on the machine is set at its lowest point. This setting has been found suitable for welding all gauge wires from #8 to #22. The extra rheostats are adjusted as needed. Small gauge wires require a lower voltage than that used for large gauge wires. Voltage should be so adjusted that the weld bead on the thermocouple junction will form slowly. If the voltage is set too high, the bead will form quickly and it has been found difficult to control its size. Through the continued use of this equipment, an operator can learn the correct setting for the rheostats to form a good weld bead.

After a positive pressure of argon gas is established inside the metal welding chamber the thermocouple wires are inserted in the chamber, as indicated in Fig. 2. The wires are then brought into contact with a carbon plate on the bottom of the chamber and then pulled back enough to create a hot arc. The wires are held in this position until a weld bead of suitable size is formed at the junction. The arc is then broken and the junction allowed to cool in the chamber. If the junction were removed from the chamber before cooling, oxidation would take place.

This method and apparatus has proved very satisfactory in comparison to the previous technique. It produces a smooth bead and eliminates the pin holes and gas pockets, as indicated in the comparison picture in Fig. 1. It also gives junctions that are stronger mechanically and which produce a more uniform EMF.

One slight disadvantage has been noted in the use of this equipment. At times "arc blow" has been encountered. This has a tendency to form the weld bead to one side of the junction. When this condition is encountered, it is necessary to position the wires so the bead will form at the bottom of the junction.

Catalyst Stack Losses Cut During Make-up Additions

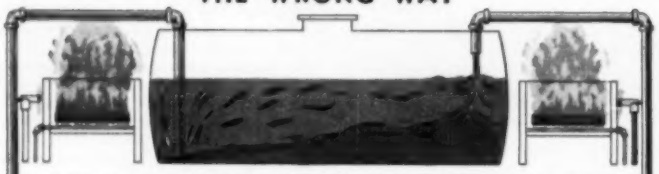
MAKEUP catalyst for the Fluid catalytic cracking unit of the Esso Standard Oil Co. Baltimore refinery normally is added in the conventional manner by a pickup connection between the carrier airline and the catalyst hoppers. Carrier air at about a pressure of 13 psi. is sufficient to carry the needed catalyst to the Fluid unit.

Frequently it was found that the catalyst flow from the bottom of the hopper was not uniform, and equipment design was such that small quantities of catalyst could not be added to the unit at low rates. This led to abnormal stack losses during addition periods. The problem was solved by the installation of a small, single inlet, air line at the lower point in the catalyst hopper. Air at above 20 psi. is introduced as needed through this small inlet, and in so doing produces turbulence in the lower section of the feed hopper.

In this way a very uniform flow of catalyst is obtained. A small bypass

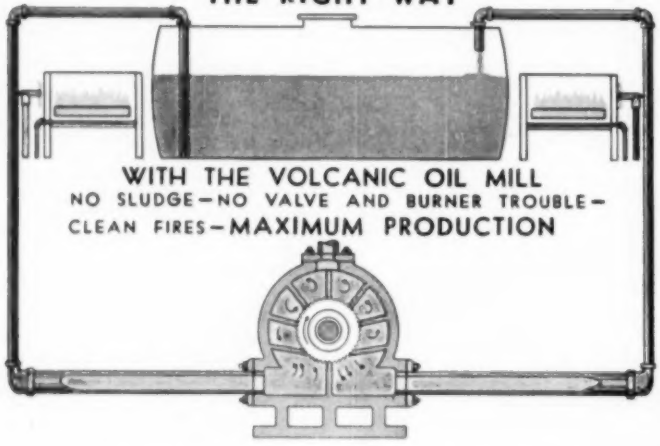
TWO WAYS OF BURNING OIL

THE WRONG WAY



SLUDGE IN STORAGE—VALVE AND BURNER TROUBLES—
UNBURNED OIL—LOST PRODUCTION

THE RIGHT WAY



WITH THE VOLCANIC OIL MILL
NO SLUDGE—NO VALVE AND BURNER TROUBLE—
CLEAN FIRES—MAXIMUM PRODUCTION

You can get complete details for a 3c stamp—try it!

HOPKINS' VOLCANIC SPECIALTIES

ALLIANCE, OHIO

line has been placed on the lower line leading from the hopper to the carrier air line. Experienced unit operators obtain very close control of the catalyst addition by watching the flow through the sight glass and manipulating the flow valve of the air inlet. Normally 20 psi. is sufficient for this small air line, however, Baltimore personnel have found that occasionally a pressure up to 42 psi. may be required.

Easy Way to Make a Cone

By W. B. MORRISON, Refinery Engineer
British American Oil Co. Ltd., Calgary, Alberta

A SIMPLE, rapid method for laying out and constructing a cone as described below can be of help to the draftsman or to the man in the shop. It is most easily explained by the accompanying sketch and the following example.

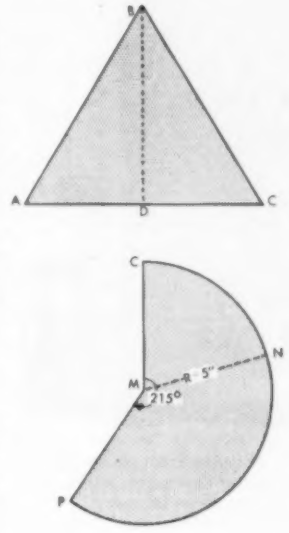
Assume it is required to make a cone four in. high and six in. in diameter at the open end. Referring to the sketches: AD = 3 in. and BD = 4 in. By solution of the right triangle, AB (length of side wall) = 5 in.

Now, the circumference of a circle of radius = 5 in. is $2\pi R = 31.4$ in. And the circumference of the desired circle at the open end of the cone is $2 \times 2 \times \pi = 18.84$ in. The angle at the center of the flat material, CMP, is $18.8/31.4 \times 360 = 215°$.

Then the material is laid flat, and:

1. With center M, radius of 5 in.; describe the arc CNP.
2. With center M, lay out angle of 215° along the arc, giving lines CM and MP.
3. Then the material is cut along CM, MP, and CNP. The resulting material folded gives the required cone.

In a similar manner a cone of any dimensions can be laid out.



Plug Device Detects Leaks and Splits Quickly in TCC Unit Kiln Coil Tubes

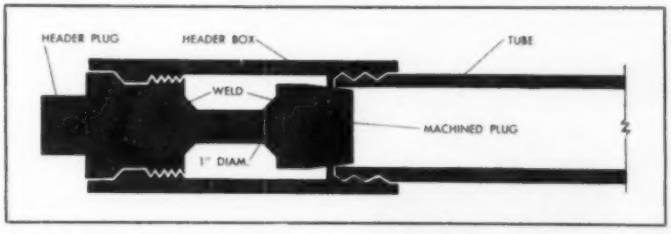


Fig. 3—Special header plug device to aid in detecting leaking or split tubes in TCC Unit kiln coils

AN especially-designed plug welded to a header plug has assisted materially in the more accurate detection of defective and leaking tubes in the Thermofor catalytic cracking unit kiln coils at the Paulsboro, N. J., refinery of Socony-Vacuum Oil Co., Inc.

The device is illustrated in Fig. 3. It consists of a short round plug of proper diameter and machined with a bevel to fit tightly into the end of

LOW-COST SOLID TEFLON RING GASKETS

Now Stocked in Standard Sizes for Immediate Delivery

You can now get solid Teflon ring gaskets in many standard sizes at mass production prices from stocks in Camden, Houston and Chicago.

In case you haven't discovered Teflon's advantages as a gasketing material, this DuPont wonder plastic is completely inert to all chemicals. Teflon cannot be attacked by nor contaminate any industrial material conveyed in piping. Thus, it is never necessary to change Teflon gaskets to suit changes in materials conveyed.

Teflon's natural slipperiness prevents any sticking of these gaskets. Extremely *antibesive*, a Teflon gasket is never defaced or torn when joints are opened. Teflon gaskets can be used over and over before needing replacement.

Sizes from 1 in. to 12 in. nominal ID for 125-150 and 250-300 lb. pressure series. Thickness—1/32, 1/16, or 1/8 in. Prices on request. Write Houston—2415 San Jacinta St.; Chicago—343 S. Dearborn St. Camden address below.

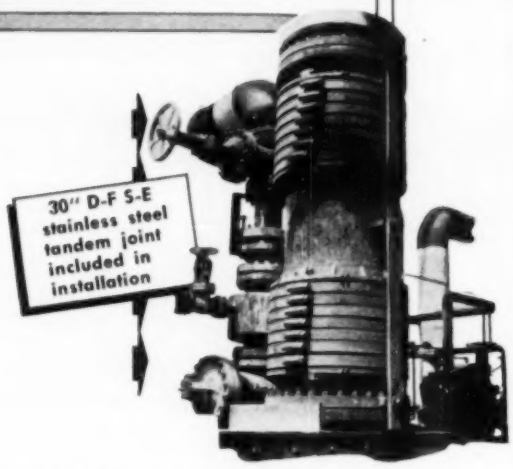
Also available—Teflon sheets, rods, tubing, bars, cylinders, and bulk Teflon packing.

Teflon Products Division

UNITED STATES GASKET COMPANY

644 N. 10th St., Camden, N. J.

FOR ITS NEW
TOLEDO REFINERY
SUN OIL
CHOOSES
Badger
EXPANSION JOINTS



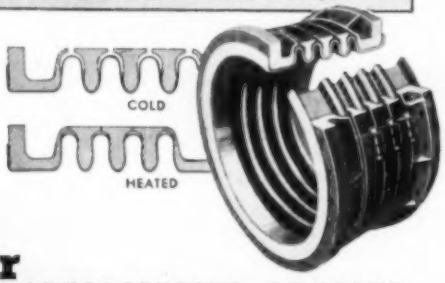
When Sun Oil Co. builds a refinery, only the best equipment is good enough. So it's no surprise to see Badger Expansion Joints at the new Toledo refinery of this giant of the petroleum industry.

The Badger Tandem Joint shown is one of several used in this installation to protect piping and equipment from damage due to both axial and lateral movements at high temperature. It is built to the famous Badger Directed-Flexing Self-Equalizing design . . . an exclusive feature that equalizes stresses between and within corrugations . . . multiplies efficiency and joint life.

Like hundreds of others, Sun Oil Co. knows from experience that these extra features in Badger Joints will keep their maintenance costs at a minimum:

- Packless . . . pressure-tight single tube
- Special forming . . . no structure-weakening stresses
- Controlled heat treating . . . assures long life
- Directed-flexing — all-curve flexing motion
- Fabricated from stainless steel or alloys for high pressure, temperature and corrosion, or from copper for normal use

Find out how Badger can save you money — write for facts today.



Badger MANUFACTURING COMPANY
230-260 BENT STREET, CAMBRIDGE, MASS.

the TCC kiln coil tubes. This plug is welded to a short piece of ¾-in. round stock, which in turn is welded to a header plug. When it is inserted in the tube end and the header plug screwed down, an effective seal is obtained.

Then steam under pressure is admitted to the coil and a close check is made on the kiln chamber temperature. If no drop in temperature occurs (due to steam escaping through a leak or a split tube), the coil is depressured, the plug device moved to the next tube, and the procedure repeated. If, on the other hand, a sharp drop in the temperature is noted, it is obvious the plugged tube is leaking badly.

Before the device was employed, the only indication denoting a bad tube was the presence of catalyst beads inside. A split did not necessarily allow beads to enter the tube and therefore often would escape detection entirely.

Old Model Potentiometer Aids New Electronic Type

INSTRUMENT panels on the crude topping unit and also on thermal cracking coils at the Lima refinery of Standard Oil Co., (Ohio) include electronic type Brown temperature indicators with multiple switch arrangements. The range of these instruments is to 1200° F., therefore satisfactory in most cases. However, there are a few thermocouples where the temperature goes up as high as 1400° F.; for example, furnace gas temperatures, bridge wall tubes, etc.

In order to cover temperature readings from these points use was made of an old Leeds & Northrup mechanical type potentiometer, which has a range to 1400° F. This instrument was installed on the panel and interconnected with the Brown multiple switch panel so that the thermocouple circuit can be thrown into the mechanical potentiometer as needed. The mechanical potentiometer also is useful in the event of power failure which would make the electronic instrument inoperative.

IDEAS—Wanted!

Plant superintendents, foremen, engineers—Send in your own ideas on "How we do it around our refinery."

The idea is the important thing. We'll dress up your drawings or photographs and write up your information. Send your contributions to:

Plant Practices Editor
PETROLEUM PROCESSING
1213 West Third St.
Cleveland 13, Ohio

Alcoa Heat Exchanger News

PUBLISHED BY THE ALUMINUM COMPANY OF AMERICA

HOW TO SAVE UP TO 80% ON TUBES

You can prove this to yourself. Check your local supplier—get his prices on tubes of all metals—then compare with Alcoa Aluminum Tube prices at the retail level. Foot for foot, metal for metal, you'll find Alcoa Tubes cutting your costs 30%, 50%, even 80%—depending on the type of tubes you now use. Many medium-sized refineries save $50,000 every year by switching to Alcoa Tubes.

Alcoa Tubes resist the hydrocarbons, hydrogen sulfide and carbon dioxide present in refinery products—as well or better than other metals. Records of 15, 20, even 25 years' continuous use are not unusual for Alcoa Tubes in heat exchanger service. Many of these case histories are available for your inspection.

Alcoa Tubes allow you a wide range of operating temperatures. They easily handle steam up to 400°F. They increase in strength and show no evidence of embrittlement as temperatures drop to −320°F and below. Using Alclad Tubes, you'll have no problems from most cooling waters.

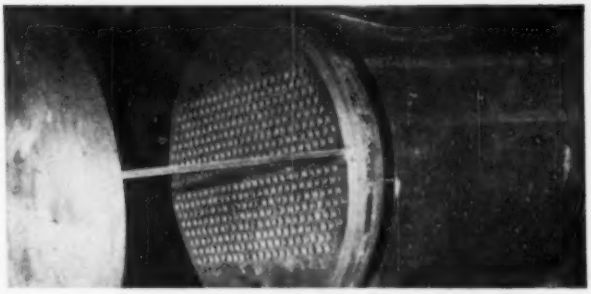
Roll-in, expanding and other fabrication go faster with Alcoa Tubes. Your present tools and techniques will do the job. Aluminum is easy to machine and to weld.

For complete information and the name of your nearest supplier, call your local Alcoa sales office. Or write: ALUMINUM COMPANY OF AMERICA, 1493L Gulf Building, Pittsburgh 19, Pennsylvania.

* * *

ALCOA OFFERS NEW BOOK

This new, 24-page booklet will answer many of your questions about Alcoa Tubes. It covers fabrication techniques . . . alloy selection . . . applications both chemical and petroleum. It describes tube cleaning, the use of inhibitors and methods of cathodic protection. It contains complete information on fluid flow and heat transfer characteristics, plus tables of physical properties and specification data. Write for your free copy, today. ALUMINUM COMPANY OF AMERICA, 1493L Gulf Building, Pittsburgh 19, Pennsylvania.



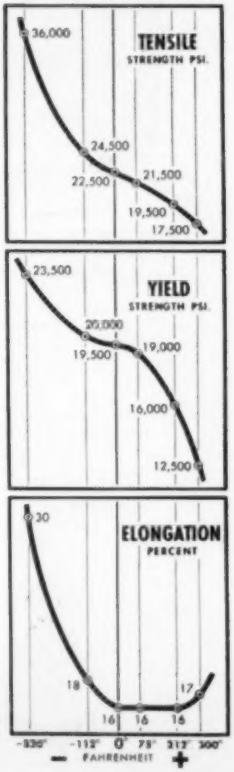
An all-aluminum heat exchanger for tonnage oxygen plant —designed and built by Stacey Bros. Gas Construction Co.

ALUMINUM TUBES EXCEL IN SUB-ZERO PROCESSING

When your process calls for temperatures down to −320°F—and your service conditions call for utmost strength—specify Alcoa Tubes. 3S alloy, for example, improves 67% in tensile strength, 23% in yield strength and more than 80% in elongation as temperatures drop from 75°F to −320°F.

The high thermal conductivity of aluminum increases the efficiency of many types of exchangers and condensers. And best of all, Alcoa Aluminum Tubes cost far less to buy and fabricate than any other suitable metals.

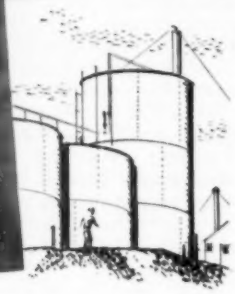
Complete information is available on Alcoa Tubes for tonnage oxygen, natural gas liquefaction, nitrogen removal, dewaxing, propane chilling, ethylene extraction and many other low-temperature processes. Call your local Alcoa sales office or write: ALUMINUM COMPANY OF AMERICA, 1493L Gulf Building, Pittsburgh 19, Pa.



These three graphs show the amazing increase in tensile properties of aluminum as temperatures drop below zero.

[To obtain more data on advertised products see page 1236]

ONE is good... FOUR are BETTER!



SHERWIN-WILLIAMS
S-W KROMIK PRIMER

with FOUR protective pigments—gives longer-lasting, lower-cost protection

Red lead alone provides protection as a primer—but red lead combined with three other active protective agents provides even tougher, longer-lasting, lower-cost protection!

That's why Sherwin-Williams KROMIK Primer offers greater resistance to moisture, rust and corrosion for tanks or any metal structures, as the exposure test panels above prove. Zinc chromate inhibits corrosion . . . zinc oxide adds strength and hardness to the film . . . red lead fortifies the water and corrosion resistance . . . iron oxide adds protection against sunlight and greater covering power. Application difficulties, excessive weight and high costs of heavy red leads are avoided.

S-W KROMIK Primer is just one of a complete line of Sherwin-Williams Maintenance Finishes engineered and proved for petroleum industry service. Ask for them—specify them—through your S-W representative, or write The Sherwin-Williams Co., Transportation Division, Cleveland 1, Ohio.

INDUSTRY'S FIRST CHOICE
PROTECTIVE PRIMING COAT FOR

TANKS
•
STRUCTURAL STEEL
•
RIGS
•
PUMPS
•
ALL INTERIOR OR EXTERIOR
STEEL SURFACES
•

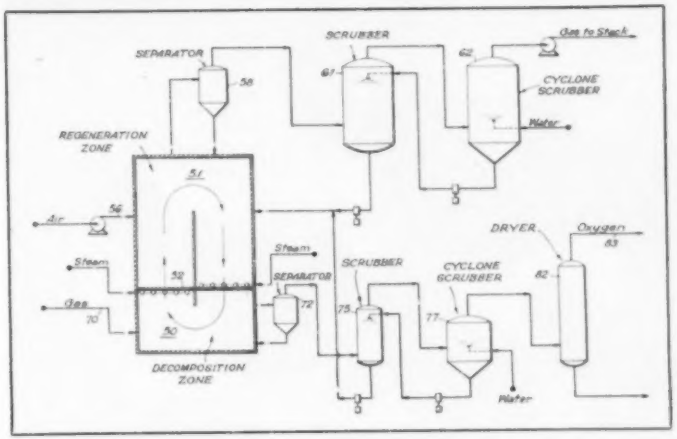
COVER THE EARTH

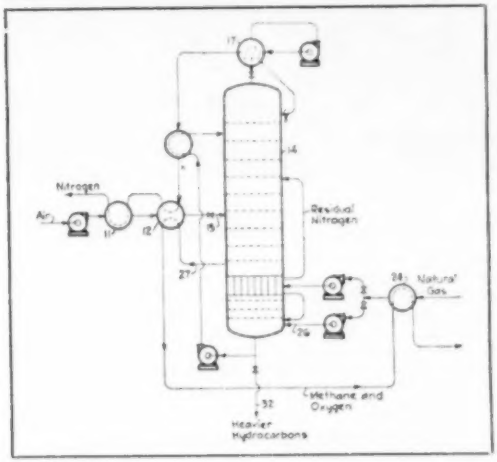
SHERWIN-WILLIAMS
MAINTENANCE FINISHES FOR THE PETROLEUM INDUSTRY

PROCESSING PATENTS

New Developments in Processes and Products

By PETER J. GAYLOR
Editor, "The Technical Survey"





ABOVE—Fig. 1—Flow diagram for the production of oxygen by use of fluidized system. (Indiana Standard — U. S. Patent 2,490,986)

LEFT—Fig. 2—System for production of a methane - oxygen fraction. (Shell Development Corp. U.S. Patent 2,519,955)

Production of Cheap Oxygen For Hydrocarbon Synthesis

APPARENTLY, the success of synthetic hydrocarbon development in the petroleum industry depends upon the production of cheap oxygen which is used to burn natural gas to carbon monoxide and hydrogen, since the use of air would involve introduction of large quantities of inert nitrogen. Hydrocarbon Research, Inc. has concentrated along liquid fractionation lines, as have Linde Air Products Co. and M. W. Kellogg Co. One recent Standard Oil Development Co. patent[1] proposes the use of carbon dioxide snow in the separation of the oxygen from air.

However, most of the other oil companies have been working on novel processes, one of which (developed by Socony-Vacuum Oil Co.) we previously described[2] as absorption from air with copper chloride eutectic, from which the oxygen is desorbed by a heating operation. Another more recent process deals with a fluidized system employing a solid oxygen carrier, disclosed in a patent issued to Standard Oil Co. (Ind.),[3] As to this operation, it is pointed out that previous chemical processes for making oxygen, such as the Brin process employing barium oxides and the duMotay process employing manganites, have been unable to compete with the liquid air process because of several inherent difficulties, some of which include the intermittent operation with lack of proper temperature control and heat balance between the various stages of the process. These difficulties are said to be overcome when a fluidized turbulent mass is continuously recycled as a psuedo-liquid stream, whereby the state of oxidation of the metal oxide is more uniformly regulated, giving greater production of oxygen.

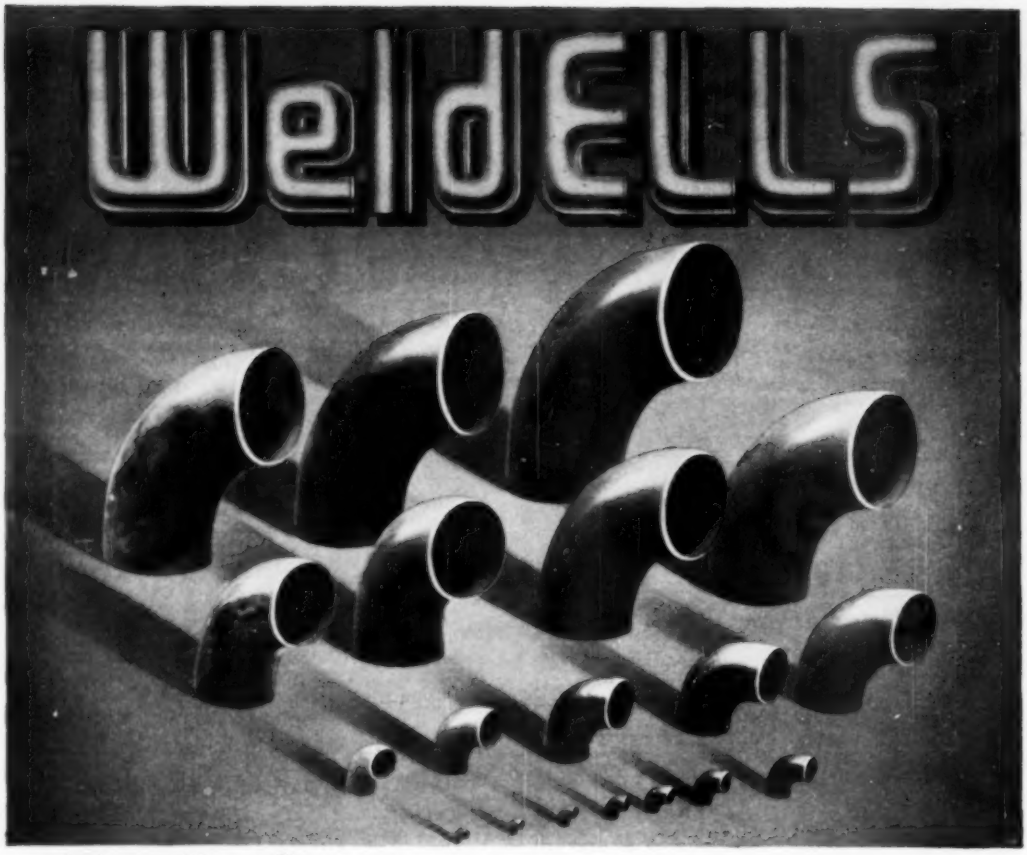
A flowsheet of the Indiana method is shown in Fig. 1. Air is introduced through line 56 into the regeneration zone 51 in which the powdered oxygen carrier (such as calcium manganite, calcium plumbate, or manganese oxides promoted with copper oxides) absorbs the oxygen from the air and is separated (from the nitrogen) by separator 58 and scrubbers 61 and 62, the latter two employing a water wash. From these scrubbers, the oxygen-rich carrier is returned to zone 51, from which it is circulated, in a fluidized condition, through porous floor 52 into decomposition zone 50, into which a combustion gas 70 is fed.

The combustion temperature in zone 50 is high enough to decompose the carrier, liberating free oxygen which is passed through separator 72, scrubbers 75 and 77 and dryer 82, the dry oxygen leaving through line 83.

Another patent recently issued to Shell Development Corp.[4] describes the production of a methane-oxygen fraction by use of a fractionation technique illustrated in Fig. 2. Here, precooled air is compressed into tower 14 through line 15, while precooled natural gas is pumped into the bottom of tower 14 through line 26. The heavier natural gas hydrocarbons are drawn off the bottom through line 32, while nitrogen is drawn off the top of the tower through exchanger 17, and is used to cool the air entering exchanger 11. The oxygen-methane fraction leaves the tower through line 27 and is used to precool the air in exchanger 12 and the natural gas in exchanger 24. The handling of mixtures of hydrocarbon with

References

(1) U. S. 2,521,400 (Standard Oil Development Co.)
(2) U. S. 2,418,402 (Socony-Vacuum Oil Co.) PETROLEUM PROCESSING 10/47 p.782.
(3) U. S. 2,490,986 (Standard Oil Co.—Ind.)
(4) U. S. 2,519,955 (Shell Development Corp.)



Family Group . . . *proud of its size . . . and traditions*

Large group though it is, you see here only one branch of the world's largest family of fittings for pipe welding.

It is simply the stock sizes of long-radius WeldELLS in a single weight and material — merely a small fraction of the enormous line that includes more types of fittings, in more materials, more weights and more sizes than any other line.

Important though the breadth of the WeldELL line is to every man who designs or erects piping, still more important is the significant fact that the WeldELL family grew to this size because nothing less could meet the demand for fittings of WeldELL quality and uniformity to satisfy every conceivable piping condition.

Yes, there is a Taylor Forge Fitting for every purpose. From the smallest to the largest, every fitting in the WeldELL line shares the principle of sound engineering design and job-speeding utility that Taylor Forge has consistently applied for half a century.

Mail the coupon for Taylor Forge catalog.

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS
P. O. Box 485, Chicago 90, Illinois
Offices in all principal cities: *Eastern Plant:* Carnegie, Pa.
Western Plant: Fontana, Calif.

☐ Please send Catalog 484 covering welding fittings and forged steel flanges.
☐ Send Bulletin 493 covering Taylor Spiral Pipe and related fittings.

NAME _____

POSITION _____

COMPANY _____

STREET ADDRESS _____

CITY _____ ZONE ____ STATE _____

Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.
715-1150

oxygen requires considerable care due to the detonating type of explosions which may result on sudden or spontaneous ignition.

Patents Issued in September

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of direct interest to the petroleum processing industries, as contained in the Official Gazettes of the U.S. Patent Office for September 5, 12, 19 and 26, Vol. 638, Nos. 1—4.

Fuels

2,521,026 (M. W. Kellogg Co.)—Motor fuel containing hydrogen sulfide and hydrogen cyanide.
2,522,922 (Gas Machinery Co.)—Composite oil gas having approximately the characteristics of natural gas.
2,523,672 (The Pure Oil Co.)—Diesel fuel containing peresters.

Conversions

2,520,983 (Sinclair Refining Co.)—Fluidized stripping and regeneration of spent conversion catalyst.
2,521,195 (Standard Oil Co.—Ind.)—Fluidized solids conversion system.
2,521,344 (Standard Oil Development Co.)—Alkylation using aluminum chloride-chloroform complex.
2,521,514 (Socony-Vacuum Oil Co.)—Phosphoric acid polymerization of thiophene compounds.
2,521,757 (Houdry Process Corp.)—Powdered catalyst conversion of heavy hydrocarbon materials.
2,521,939 (Socony-Vacuum Oil Co.)—Catalytic polymerization of olefins with hydrogen bromide promoter.
2,521,940 (Socony-Vacuum Oil Co.)—Removal of catalyst from olefin polymer product.
2,522,065 (Phillips Petroleum Co.)—Catalytic desulfurization and reforming with bauxite.
2,522,696 (Sinclair Refining Co.)—Catalytic conversion of naphtha for production of high antiknock gasoline.

Refining

2,521,357 (Socony-Vacuum Oil Co.)—Deasphalting petroleum oils with porous contact material.
2,521,761 (Texaco Development Corp.)—Desulfurizing crude oil with sulfur-consuming bacteria.
2,521,870 (Standard Oil Co.—Ind.)—Disproportionation of organic disulfides.
2,522,026 (Phillips Petroleum Co.)—Apparatus for vaporizing liquefied gas.
2,522,059 (Phillips Petroleum Co.)—Separating methane from higher hydrocarbons with o-anisidine.
2,522,065 (Phillips Petroleum Co.)—Catalytic desulfurization and reforming with bauxite.
2,522,354 (Socony-Vacuum Oil Co.)—Gas-solid contact apparatus.
2,522,378 (Owens-Corning Fiberglas Corp. and Standard Oil Co.-Ind.)—Resolving water and oil emulsions.
2,522,426 (Standard Oil Development Co.)—Extracting hydrocarbon gases with fluidized powdered adsorbent.
2,522,429 (Standard Oil Development Co.)—Resolving oil emulsions.
2,522,475 (Standard Oil Development Co.)—Disposing of fumes of sulfuric acid.
2,522,618 (Standard Oil Co.-Ind.)—Extraction of aromatic and sulfur compounds with amine sulfonate.
2,522,619 (Standard Oil Co.-Ind.)—Extraction of oxygenated compounds with amine sulfonate.
2,522,640 (Petrocarbon Ltd.)—Separation of hydrocarbon gases at low temperatures.
2,522,787 (Phillips Petroleum Co.)—Liquefying gases.
2,523,149 (Standard Oil Development Co.)—Fractionating gases with solid adsorbents.
2,523,549 (Phillips Petroleum Co.)—Deoxygenation of hydrocarbons free of sulfur compounds by disalicylalethylenediimine on carrier.
2,523,681 (Shell Development Co.)—Solvent extraction of unsaturated hydrocarbons with phenol and silver nitrate.
2,523,747 (Stearns-Roger Manufacturing Co.)—Recovery of gasoline from enriched absorber oils.

Chemicals

2,520,947 (Phillips Petroleum Co.)—Recovery of hydrogen halides from liquids.
2,521,022 (Interchemical Corp.)—Synthetic hydrocarbon resin.
2,521,147 (Standard Oil Co.-Ind.)—Electrolytic production of alkane sulfonic acids.
2,521,233 (Phillips Petroleum Co.)—Absorption of nitrogen by liquid ammonia.
2,521,359 (Standard Oil Development Co.)—Copolymers of cyclopentadiene.
2,521,361 (Standard Oil Development Co.)—Plasticized copolymer.
2,521,425 (Universal Oil Products Co.)—Stabilizing phenylene diamines with amine-SO_2 reaction products.
2,521,429 (Standard Oil Development Co.)—Thiophene from diolefin, H_2S and NH_3.
2,521,436 (Standard Oil Development Co.)—Fatty acid production in hydrocarbon synthesis.
2,521,437 (Standard Oil Development Co.)—Softening Buna S with copolymer.
2,521,444 (California Research Corp.)—Separating alkyl benzenes.
2,521,466 (California Research Corp.)—Phthalic anhydride from o-xylene, etc.
2,522,915-6 (California Research Corp.)—Dihydrocarbon peroxides.
2,522,212 (Shell Development Co.)—Concentrating aqueous hydrocarbon sulfates and sulfonates.

SAVES TANKS - SAVES STEEL

Having new tanks treated by NATASCO is the sure way of getting the ultimate in use from them over a long period of years. Old tanks will also give many years additional service by receiving the proper NATASCO treatment. NATASCO protects the steel surface from all corrosion. Due to the increasing shortage of steel, and its rising cost, NATASCO service provides substantial savings.

SAVES OIL

Evaporation of volatile fractions and loss through leakage has accounted for smaller profits in many oil firms. In most cases *this loss could have been prevented if the tanks had been serviced by NATASCO.*

SAVES DOLLARS

If you have added additional years of service life to your tanks and have eliminated loss by evaporation and leakage, *you have added profits to your business.*

Every NATASCO job is Guaranteed

Wire, Write or Telephone for complete information on how NATASCO can solve your corrosion problems.

THE Natasco COMPANY

Lease Tank Service—West Texas Area: Williams Construction Company, Odessa, Texas

California Representative: Coast Contractors, Ltd., 4636 E. Slauson, Maywood, Cal.

[To obtain more data on advertised products see page 1236]

For easier, better welding . . .

GRINNELL WELDING FITTINGS

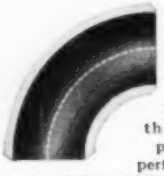
A qualified welder can make welds quickly and easily with Grinnell Welding Fittings. These fittings are made by a hydraulic forging process that assures uniform wall thickness at all points and true circularity throughout. Of seamless, one-piece construction, they can be cut at any angle to match up with standard weight, and extra strong and heavier wall pipe in I.D. or O.D. sizes. Pressure-temperature ratings are equal to or greater than those of seamless steel pipe. Grinnell Welding Fittings are process stress-relieved.

Permanent Identification

Each Welding Fitting bears a metal plate giving size, wall thickness, material and name for easy, positive identification.

Full Length Outlets

Full length outlets permit fast lining up and ample room for rod manipulation; keep high welding heat away from vital crotch zones.



Uniform Wall Thickness

Uniform wall thickness at all points permits perfect lineup with pipe, O.D. and I.D. No thinning of long outer wall . . . no thickening of short inner wall. Complies with code requirements.

True Circular Section

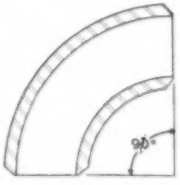
True circular section at all points makes fitting easy to align and weld . . . no distortion or flattening to affect flow adversely.

Plain Circumferential Butt Welds

Grinnell Welding Fittings confine all welds to plain circumferential butt welds—with their inherent strength and simplicity.

Accurate Bevels

Accurate bevels aid aligning and welding. Standard straight bevel for thickness (T) $\frac{3}{16}$ to $\frac{3}{4}$ inch inclusive. Standard U-bevel for thickness (T) greater than $\frac{3}{4}$ inch.



True Included Angles

True included angles permit fabrication and erection of complicated piping systems to exact measurements.

Send for copy of this new catalog showing the complete line of Grinnell Welding Fittings and Forged Steel Flanges.

GRINNELL

Grinnell Company, Inc., Providence, R. I. Branches: Atlanta • Billings • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston Long Beach • Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Pocatello • Philadelphia • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

2,522,355 (Socony-Vacuum Oil Co.)—Thiophene condensation products.
2,522,455 (Standard Oil Development Co.)—Copolymer of aliphatic monoolefin with dihydronaphthalene.
2,522,589-90 (Shell Development Co.)—Photochemical reaction of unsaturated ethers with H_2S and mercaptans.
2,522,676 (Socony-Vacuum Oil Co.)—Dehydrogenation of alcohols with sulfur.
2,522,678 (Socony-Vacuum Oil Co.)—Recovery of oxidized petroleum products.
2,522,687 (Ethyl Corp.)—Hydrocarbon halides produced in presence of gallium trihalide.
2,522,722 (Union Oil Co. of Calif.)—Thiophene acylation with catalyst of sulfuric acid-monocarboxylic acid complex.
2,523,150 (Standard Oil Development Co.)—Resinous copolymers of diolefins with refinery C_4 cuts.
2,523,154 (Standard Oil Development Co.)—Purifying petroleum phenols.
2,523,168 (Standard Oil Development Co.)—Continuous polymerization of isobutylene and isoprene.
2,523,490 (Standard Oil Co.-Ind.)—Recovery of lower alkanoic acids from sulfonation reaction products.
2,523,554 (Phillips Petroleum Co.)—Furfural purification.
2,523,580 (Phillips Petroleum Co.)—Alkyl pyridines.
2,523,582 (Union Oil Co. of Calif.)—Sulfonation process.
2,523,596 (Phillips Petroleum Co.)—Emulsion polymerization in presence of mercaptan.
2,523,609 (Universal Oil Products Co.)—Cobodied drying oils.
2,523,686 (Shell Development Co.)—Acetone by hydration of propylene.
2,523,707 (California Research Corp.)—Hydroxy toluenes (m-cresol).
2,523,926 (Phillips Petroleum Co.)—Rubbery butadiene-styrene copolymer.

Lubricants

2,521,415-6 (Universal Oil Products Co.)—Stabilization of organic compounds with N-(4 hydroxyphenyl) isoindoline.
2,521,438 (Standard Oil Development Co.)—Low temperature grease.
2,521,626 (USA)—Fluorinating petroleum lubricating oil.
2,522,155 (Shell Development Co.)—Lubricants containing polymers of glycidyl isopropyl ether.
2,522,312 (Gulf Oil Corp.)—Antioxidants for mineral oil lubricants.
2,522,460 (Standard Oil Development Co.)—Lubricating grease containing channel carbon black of pH 9.
2,522,476 (Standard Oil Development Co.)—Stabilized unsaturated fatty oils.
2,522,489-90 (Socony-Vacuum Oil Co.)—Trithianyl-trithio-orthoformate and oils containing it as antioxidant.
2,522,512 (Shell Development Co.)—Synthetic lubricant by heating H_2S with diallyl ether.
2,522,669-70 (Socony-Vacuum Oil Co.)—Synthetic lubricants from normal aliphatic mercaptans and ketones.
2,522,965 (Minnesota Mining & Manufacturing Co.)—High boiling fluorocarbons.
2,523,100 (Standard Oil Development Co.)—Mineral oil and phenol sulfide additive.
2,523,146 (Standard Oil Development Co.)—Disulfide derivatives of thiophosphoric and thiophosphorous acid esters.
2,523,147 (Standard Oil Development Co.)—Organic substituted acids of phosphorus.
2,524,017 (Cincinnati Milling Machine Co.)—Metal working lubricant.

Hydrocarbon Synthesis

2,520,925 (Hydrocarbon Research, Inc.)—Synthesis gas generation.
2,521,400 (Standard Oil Development Co.)—Oxygen separation.
2,521,538 (Texaco Development Corp.)—Hydrocarbon synthesis.
2,522,468 (Standard Oil Development Co.)—Synthesis gas.
2,523,248 (Cities Service Oil Co.)—Separation of alcohols and acids from Fisher-Tropsch synthesis product.
2,523,284 (The Texas Co.)—Hydrogen and carbon monoxide production.

Specialties

2,521,402 (Standard Oil Development Co.)—Liquid media for operation of hydraulic mechanisms (hydraulic oil).
2,521,424 (Standard Oil Development Co.)—Copper acetylide as fungicide.
2,522,469 (Standard Oil Development Co.)—Protective coating composition.
2,522,518-9 (Sinclair Refining Co.)—Stabilized ammonium mahogany sulfonates.
2,523,114 (Standard Oil Development Co.)—Methoxy dicyclopentadiene mercuric chloride for controlling parasites.
2,523,177 (Standard Oil Development Co.)—Ethylene diamine condensation products and paraciticidal compositions.
2,523,705 (Lovell Chemical Co.)—Synthetic wax of carnauba type from conjoint crystal of polyethylene and paraffin.
2,523,898 (Phillips Petroleum Co.)—Corrosion inhibition with alkyl sulfenamide.

Catalysts

2,521,431-2 (Standard Oil Development Co.)—Activation of Friedel-Crafts catalyst.

Miscellaneous

2,521,477 (Gulf Oil Corp.)—Measuring liquid content in a vessel.
2,522,406 (Phillips Petroleum Co.)—Valve.

How to Obtain Patents

Readers may obtain copies of any U. S. patent from the Patent office at 25 cents each. Order by patent number direct from the Commissioner of Patents, Washington 25, D. C.

NEW LIFE FOR OLD DRUMS

after only 6 minutes of Oakite cleaning

SEND for *free* Booklet. Packed with helpful hints on cleaning, derusting, descaling bubble towers, heat exchangers, pumps, valves, tools, etc.

That's right—used drums restored to first-rate condition—cleaned, rinsed and dried—after only 6 minutes! That's how fast specialized Oakite cleaning works.

Reconditioning barrels and drums the Oakite way has these extra advantages: Fewer rejects . . . more uniform paint stripping . . . better adhesion for new paint. Eliminates paint build-up on steam coils . . . stops clogging of drains and sewers.

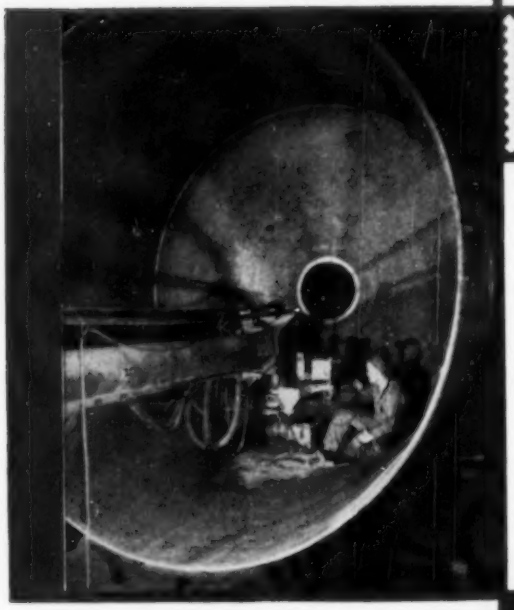
Your local Oakite Technical Service Representative will gladly help *you* get better, faster drum conditioning. Call him today. Or write for free booklet. No obligation either way.

OAKITE PRODUCTS, INC., 108 Thames St., NEW YORK 6, N. Y.
Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE

PETROLEUM SERVICE DIVISION

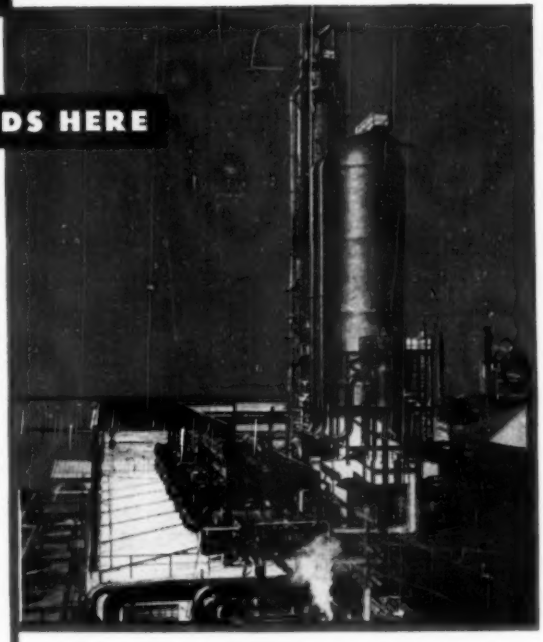
[*To obtain more data on advertised products see page* 1236]



Another Example of B&W Research, Engineering, & Facilities

THIS *Plus* Value IN B&W PROCESS EQUIPMENT

PAYS DIVIDENDS HERE



ILLUSTRATED above is a typical example of the advanced welding practices employed at B&W for the fabrication of pressure vessels. B&W's history of resourceful engineering is distinguished by a 25-year-old succession of developments and improvements in welding machines, automatic controls, techniques, coating of electrodes, inspections, and tests.

B&W's leadership in welding—beginning in 1930 with the first welded boiler drum approved by an engineering authority for high-pressure operation—is being applied to an ever-broadening range of quality-welded vessels for high and low temperatures and pressures, and for corrosive services. Chances are B&W has the economical solution to your process equipment problems. The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

BABCOCK & WILCOX

S-401

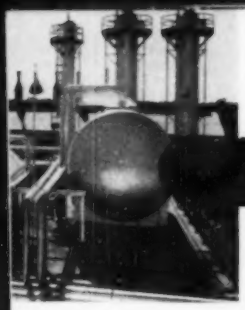


Photo-Cell Type Flow Meter Compensates for Square Root

A DIFFERENTIAL pressure flow meter has been designed which is compensated automatically for the square root relationship of the flow rate and the height of the liquid column in the manometer so that rate of flow may be read directly on an indicator scale graduated in decimal units.

The instrument is shown schematically in Fig. 1, in side and front elevational views. It consists of a stabilized light source 5, mounted at the focus of a highly polished, parabolic reflector 6 so that light rays from the source will be reflected in parallel condition, impinging on a so-called light valve 7. Light valve 7, provided with a slot 8 of predetermined shape, is mounted in front of one leg of a transparent U-tube manometer 9 containing an opaque liquid 10 such as mercury. The manometer is connected to the primary element of a pressure differential flow meter device, so that the mercury level will be responsive to and vary with the flow of fluid through the main pipe.

The parallel light rays which pass through slot 8 also pass through that portion of the U-tube which is not filled with mercury. They strike a second parabolic reflector 11, which has a photo-electric cell 12 at its focus. Current generated in photocell 12 is directly proportional to the amount of light reaching it. This current is amplified to a suitable level, empoying an electronic circuit of linear characteristics, then is transmitted to a current-responsive indicator of any suitable design which will convert the current variations into a measurement of fluid flow in any desired units on a calibrated scale.

Square root compensation is obtained in the design of light valve 7. Slot 8 is so proportioned that the area uncovered by the vertical movement of the mercury column, due to differential pressure caused by the fluid flow, is proportional to the square root of the height of the mercury column. The light passing through slot 8 will therefore be directly proportional to the flow, and the current generated by this light, when focussed on cell 12, will also be in direct proportion to the fluid flow.

Light rays which pass to either side of light valve 7 will also reach the cell 12 and induce a flow of current. However, the intensity of these rays will not vary. Therefore, the current induced by them will be constant and will affect only the zero adjustment of the flow meter.

U. S. 2,521,784, issued Sept. 12, 1950, to Gordon O. Garis, assignor to Celanese Corp. of America.

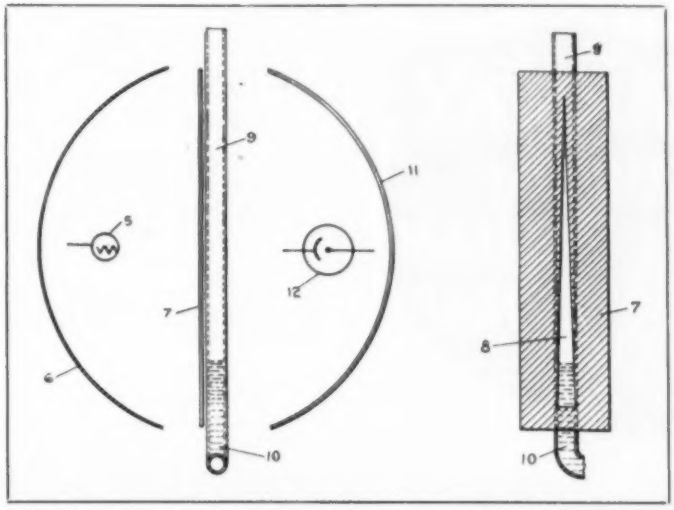


FIG. 1—Novel flow meter incorporates square root compensation (U. S. 2,521,784)

Venturi Type Bubble Cap Ups Contact Efficiency in Towers

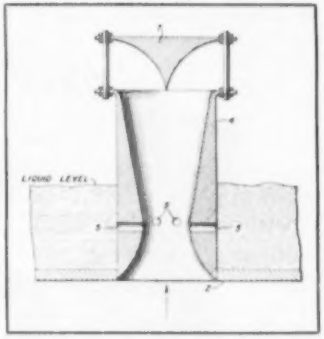


FIG. 2—Venturi type bubble cap for fractionating columns (U. S. 2,523,126)

VENTURI type elements in place of conventional bubble cap design will improve the operation of fractional distillation columns, it is claimed. They accomplish more efficient contact between gas and liquid because the liquid is dispersed in the vapor phase rather than the gas being dispersed in the liquid phase, which usually occurs with normal bubble caps, it is stated.

The Venturi design may also be employed in counter-current liquid-liquid extraction processes to obtain more efficient contact. In that case, its advantage is based on the dispersion of the heavy liquid in the lighter or vice versa, with the design modi-

fied to suit each type of operation.

Fig. 2 illustrates the element in cross section. It comprises the Venturi itself as indicated by 4, plus a deflector 7 of substantially conical shape to prevent straight-through flow of vapor. The apex of the deflector extends into or toward the outlet of the Venturi. Elements 4 are located on each tray 2 in a given column so as to avoid alignment with similar elements on the plates above or below.

Distribution of elements over an entire plate is not critical. However, it is preferred that they be so arranged as to provide a minimum of interference with the flow of fluid across the plate. They should therefore be disposed in uniform rows (square pitch rather than triangular pitch). They should also be spaced by a distance not less than two diameters.

The same general dimensions as are required for any Venturi device should be followed. The diameter of the Venturi inlet may be taken as the controlling dimension. It is contemplated that this diameter be in the range of one to four inches. The length of the element should be not substantially less than twice the inlet diameter, with the Venturi throat located at a distance from the inlet approximately ¼ the total length of the element, and the throat diameter being ¼ to ½ the inlet diameter. Inspirating tubes 5 open outwardly through element 4 at the narrowest part of the throat. Their diameter should be not less than 1/16 inch to avoid plugging, and not more than ¼ the throat diameter.

U. S. 2,523,126, issued Sept. 19, 1950, to John D. Long, Caraca, Venezuela, assignor to Standard Oil Development, Co.

Patents Issued in September

The following classified listing covers patents issued during the month of September, 1950, believed to be of interest or value to petroleum processing or handling operations:

Catalytic Reactors

2,521,195 (Standard Oil Co.—Indiana)—Improved control of cyclic flow of solids through a fluidized solids conversion system.

2,522,354 (Socony-Vacuum Oil Co., Inc.)—Gas-solid contact apparatus of the moving bed type.

Processing, general

2,521,369 (The Air Preheater Corp.)—Multi-fluid heat exchanger.

2,521,380 (Columbian Carbon Co.)—Centrifugal separator, specifically for separating aerosols from gaseous media.

2,521,396 (The Turbo-Mixer Corp.)—Contact equipment for processing or treatment of liquids with gases or vice versa.

2,521,785 (Metal Textile Corp.)—Separator for removing entrained liquid particles from a flowing gaseous medium.

2,522,425 (Standard Oil Development Co.)—Tunnel type bubble cap baffle.

2,522,787 (Phillips Petroleum Co.)—Apparatus for liquefying gases.

2,523,126 (Standard Oil Development Co.)—Apparatus for countercurrent contact of fluid materials.

2,523,174 (The Lummus Co.)—Heat exchanger of shell and tube type.

2,523,971 (Stone & Webster Engrg. Corp.)—Thermal processing furnace.

Instruments

2,521,477 (Gulf Oil Corp.)—Gage to measure variations in density of a liquid in a vessel and indicate remotely.

2,521,784 (Celanese Corp. of America) — Square root-compensated flow meter.

2,521,194 (Globe American Corp.)—Liquid level meter.

2,522,258 (Chester Fanshier)—Liquid level gage for liquefied petroleum gas.

2,522,480 (Taylor Instrument Cos.)—Tube and Bourdon spring.

2,523,121 (Owens-Corning Fiberglas Corp.)—Gaseous fuel analyzer.

Valves and Fittings

2,521,166 (Tri-Clover Machine Co.)—

2,521,692 (William A. Costello)—Baffle packing for valve stems for high pressure and high temperature service.

2,522,145 (Robert O. Thompson)—Expansion safety valve.

2,522,231 (Henrite Products Corp.)—Fluid seal for rotating or sliding shafts.

2,522,406 (Phillips Petroleum Co.) — Outlet valve for liquefied petroleum gas storage tanks.

2,522,785 (Kenneth Cecil Hanson; Surbiton, England)—Pipe joint and union.

2,523,068 (Black, Sivalls & Bryson, Inc.)—Vessel safety head.

2,523,458 (Ole Vogel; Moose Jaw, Saskatchewan, Can.)—Valve wheel marker.

2,524,009 (Crane Co.)—Baffle arrangement for a high pressure valve or fitting.

Tools

2,520,920 (Independent Pneumatic Tool Co.)—Rotary impact tool.

2,521,419 (Albert E. G. Sellers)—Ratchet-actuated open-end wrench.

2,521,816 (Raymond B. Adams)—Double spiral ratchet wrench.

2,521,966 (Norman F. Clayborne)—Valve seat and valve stem gaging apparatus.

2,522,927 (Florence Pipe Foundry & Machine Co.)—Pipe-testing machine.

Pumps and Compressors

2,521,236 (William H. MacPherson)—Rotary pump.

2,521,592 (Albert E. McManus)—Sliding vane rotary pump.

2,523,317 (Daniel F. McGill)—Rotary type air compressor.

2,523,543 (James E. Smith)—Variable stroke radial pump.

Tanks and Storage Vessels

2,523,274 (Chicago Bridge & Iron Co.)—Support for spherical type tanks.

2,523,292 (Chicago Bridge & Iron Co.)—Floating roof seal.

2,523,318 (Chicago Bridge & Iron Co.)—Balloon type gasholder.

Miscellaneous

2,522,962 (John H. Reger)—Fire extinguisher.

2,523,508 (Lowell A. Ledgett)—Three-dimensional model, adapted for designing chemical processing plants in particular.

How to Obtain Patents

Readers may obtain copies of any U. S. patent from the Patent Office at 25 cents each. Order by patent number direct from the Commissioner of Patents, Washington 25, D. C.

ONLY ONE MOVING PART..

A small, stainless steel valve that *floats on the condensate load*... keeps maintenance at a minimum. Continuous discharge under heavy loads, frequent under light loads, gets equipment hotter, sooner and keeps it hot. Over 600,000 Yarways already installed. Sold by distributors throughout the world.

YARNALL-WARING CO. 153 MERMAID AVENUE, PHILA. 18, PA.

Dependable Selectivity...

Efficient H_2S removal in the presence of CO_2

Dependable, low-cost removal of H_2S in the presence of large volumes of CO_2 is a primary advantage of the Shell Phosphate Process. All but harmless amounts of H_2S are removed while most of the CO_2 is left untouched.

Important too is the fact that the treating process has no harmful effect upon subsequent processing operations. The treating agent is inorganic . . . non-contaminating to hydrocarbons.

Low operating costs are the rule with the Shell Phosphate Process. Since a minimum of CO_2 is removed, steam regeneration of the treating solution costs less. Also, because the regenerated H_2S is in a relatively high concentration, the cost of conversion to solid sulphur or sulphuric acid is greatly reduced.

The Shell Phosphate Process is available to any operator under license from the Shell Development Company . . . together with experienced engineering service for its design, installation, and operation.

SHELL

SHELL DEVELOPMENT COMPANY

50 West 50th Street, New York 20, N. Y.

Peace on Earth,

Good Health to Children...

For the sake of your children, and your children's children, make sure you buy and use Christmas Seals.

Christmas Seal funds have fought tuberculosis since 1907. And today your children have a far greater chance of escaping TB than you did.

Yet tuberculosis still kills more people than all other infectious diseases. So give your children a still better chance. Send your contribution today.

buy Christmas Seals

Because of the importance of the above message this space has been contributed by

PETROLEUM PROCESSING

NEWS OF SUPPLIERS

Manufacturers
Distributors
Engineering Firms

Petreco Consolidates Its Office, Laboratory, Manufacturing Facilities

The Petroleum Rectifying Co. has consolidated its office, laboratory, service and manufacturing facilities at 1390 East Burnett St., Long Beach 6, Calif. A new office building was constructed and recently occupied and existing buildings modernized.

American Meter Names Satterwhite

Mr. Satterwhite

American Meter Co. has announced the election of J. H. Satterwhite as president of the Westcott & Greis, Inc., Division, with headquarters in Tulsa. A graduate of the Virginia Polytechnic Institute in 1911, Mr. Satterwhite was associated with several natural gas companies until 1917, when he began a long association with Westcott & Greis and some of its subsidiary organizations. Westcott & Greis became a division of American Meter in 1933.

Mr. Satterwhite was active in the formation of the Natural Gasoline Supplymen's Association, and is a past president of that organization.

Build Addition to Kure Beach

A new Harbor Island addition to the Kure Beach corrosion testing project near Wilmington, N. C., has been established by International Nickel Co., Inc. With a new laboratory and marine exposure racks which have been located at Harbor Island, the Kure Beach project now has increased facilities for the study of over 20,000 specimens of all types of materials in sea water and sea air. The sea water tests were originally located at Kure Beach, where they were first set up in 1935. They were moved this year to the new station, about 20 miles north. The atmospheric testing lot, covering about an acre of ground, is still at Kure, as is a station about 80 ft. from the shoreline for testing the effects of sea water spray.

Hackley Is Houdry Vice President

Mr. Hackley

Roy C. Hackley, Jr., formerly with the U. S. Dept. of Justice, has been appointed vice president in charge of patents and licensing for the Houdry Process Corp. He was Special Assistant to the Attorney General and Chief of the Patent Section of the Justice Dept., and had been associated with the government since 1943.

Prominent in law circles throughout the nation, Mr. Hackley has held or is now holding the following posts: chairman, patent section, American Bar Association; 2nd and 1st vice president, American Patent Law Association; president, national council, American Patent Law Association; vice president, International Association for the Protection of Industrial Property; and three years as associate professor of law, American University, Washington College of the Law, among many others.

UOP Salutes Blankenship

Testifying to the high regard and importance it attaches to good advertising and public relations was the dinner held by Universal Oil Products Co. for members of the trade press and advertising profession in honor of Harvey W. Blankenship, director of public relations, Friday evening, Sept. 29.

Mr. Blankenship

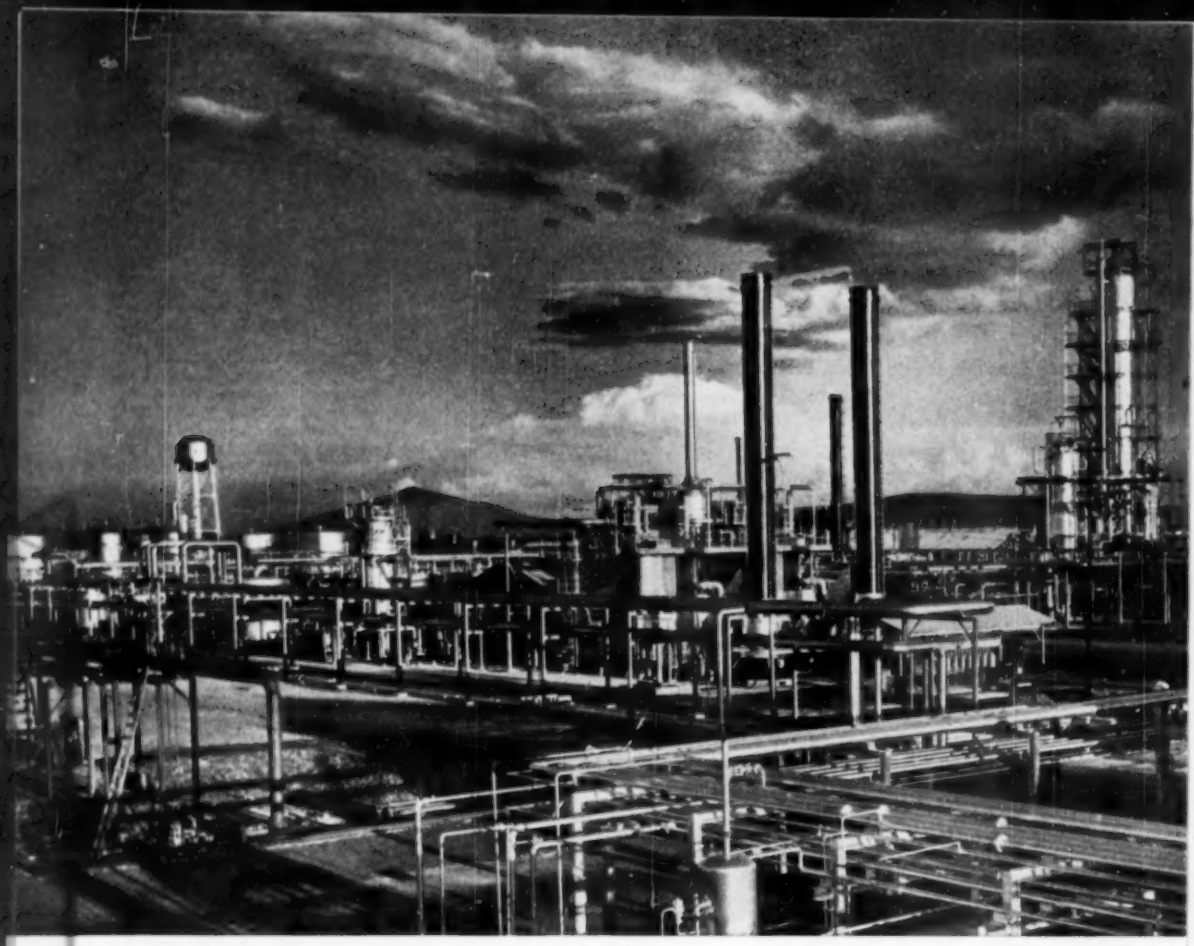
Dr. Gustav Egloff, UOP director of research, spoke briefly on the history and achievements of the company, Dr. R. L. Putnam of Putnam Publishing Co. discussed the place of advertising in industrial sales, and David W. Harris, president of UOP, acted as master of ceremonies. Held in the Crystal Ballroom of the Blackstone Hotel, Chicago, the program will long be remembered as a tribute to the outstanding job done by Mr. Blankenship and as a recognition by management of the part played by good public relations and advertising in modern business.

Natasco Buys Automatic Gage Firm

Natasco Co. of Tulsa has purchased the patents, shop, and equipment of the Nelson Automatic Gauge Co., also of Tulsa. The latter firm manufactures a line of gaging equipment which permits accurate gaging of an unlimited number of tanks, from distant control stations, with a maximum of three seconds per tank. Products are expected to become available soon in all refining and production areas.

Phillips Offers Glass Blowing

The Phillips Petroleum Co.'s glass blowing laboratory at Bartlesville, Okla., is now offering a complete service for the fabrication, modification, or repair of glassware items of unusual or intricate design not other-



New 30,000 Barrel Pemex Refinery at Salamanca

Engineered and Constructed by Arthur G. McKee & Company

LOCATED in an important industrial and agricultural area of the high plateau region of México, this refinery is one of the most beautiful ever built. Sound, thorough engineering is clearly evident in its well-planned, clean-lined arrangement and efficient construction.

The complete refinery is comprised of processing units for Crude Distillation, Thermal Cracking and Catalytic Desulfurization and units for gasoline and kerosene treating and ethyl blending. Power plant, steam plant, water supply system, tankage and extensive shop and maintenance facilities are provided.

With a 30,000-barrel-per-day capacity, this new refinery is designed to produce gasoline, kerosene, diesel oil, other gas oils, liquefied petroleum gas and residual fuel oil

ARTHUR G. McKEE & COMPANY

DESIGN, ENGINEERING AND CONSTRUCTION FOR THE PETROLEUM REFINING AND IRON AND STEEL INDUSTRIES

ENGINEERS AND CONTRACTORS • ESTABLISHED 1905
2300 CHESTER AVENUE, CLEVELAND
30 Rockefeller Plaza, New York, N. Y.

wise readily available. R. J. Brunfeldt is in charge of this specialized operation. Such service previously was limited to the company's own requirements.

Equipment is available to manufacture such glass structures as vacuum tubes, pumps, columns, stills, condensers, and micro distillation apparatus. Finished pieces are checked for strains by polariscopic examination. Sales will be handled by W. C. Lacy, manager, instrument sales section of the Chemical Products Division of Phillips.

Cooper Alloy Promotes Hookway

Cooper Alloy Foundry Co., Hillside, N. J., has appointed William C. Hookway, Jr., assistant to the chief engineer. Mr. Hookway was formerly sales representative in the New Jersey territory. James Ziegler, presently the sales representative of the Pittsburgh-Cleveland district, will cover the New Jersey territory.

Prior to joining Cooper Alloy, Mr. Hookway was employed by H. A. Wilson Co. and for eight years as marine engineer for Gibb and Cox, Inc. He holds a B.S. degree in Industrial Engineering from Lehigh University.

GATX Opens Chicago Tank Terminal

General American Transportation Corp. has opened a fifth public tank storage terminal for storage of petroleum and chemical products. It is centrally located in the Midwest, in Chicago's Clearing Industrial District, at 67th and Archer on the Sanitary and Ship Canal, and is served by all of the railroads which come into the city. All equipment is leased. Details may be obtained by writing General American Terminals, Chicago 90, Ill.

Kellogg Opens Canadian Pipe Shop

Canadian Kellogg Ltd., a subsidiary of M. W. Kellogg Co., has begun operations in a new pipe fabricating shop in Edmonton, Alta. With an approximate monthly capacity of 400 tons, the shop is equipped to fabricate not only carbon steel and low chrome piping, but also specialty materials such as stainless steel and high nickel alloys in a full range of pipe sizes.

Personnel Changes

R. S. Aries & Associates— Major General Alden H. Waitt (Ret.) has joined the company as vice-president. He was formerly chief of the Chemical Warfare Service. A graduate of M.I.T., with B.S. and M.S. degrees, he was a member of the M.I.T. Research Laboratory of Applied Chemistry from 1925-27 and taught at the University of Kentucky from 1915-

HAVE YOU SEEN THIS NEW BOOKLET?

Condensed information on the function, applications and resultant economies obtainable through this modern development in Entrainment Separation.

The effectiveness of METEX MIST ELIMINATORS has been demonstrated by installations of several years' standing both in this country and abroad. Used in vacuum pipe stills, scrubbing towers, knock-out drums, evaporators and similar equipment and equally adaptable to new or existing installations, they have effected such marked economies as:

1. 95% or better entrainment removal
2. End-product quality secured even with lower-cost raw materials
3. Operation at full capacity without contamination
4. Practical elimination of re-runs

Write for your copy today. The coupon below is for your convenience. No obligation, of course.

METAL TEXTILE CORPORATION
631 EAST FIRST AVE., ROSELLE, N. J.

METEX QUALITY PRODUCTS

Metal Textile Corp.
631 East First Ave., Roselle, N. J.
I would like to have a copy of your new booklet, Metex Mist Eliminators
Name ..... Title .....
Company .....
Address .....
City ..... State .....

[To obtain more data on advertised products see page 1236]

GULF OIL CORPORATION

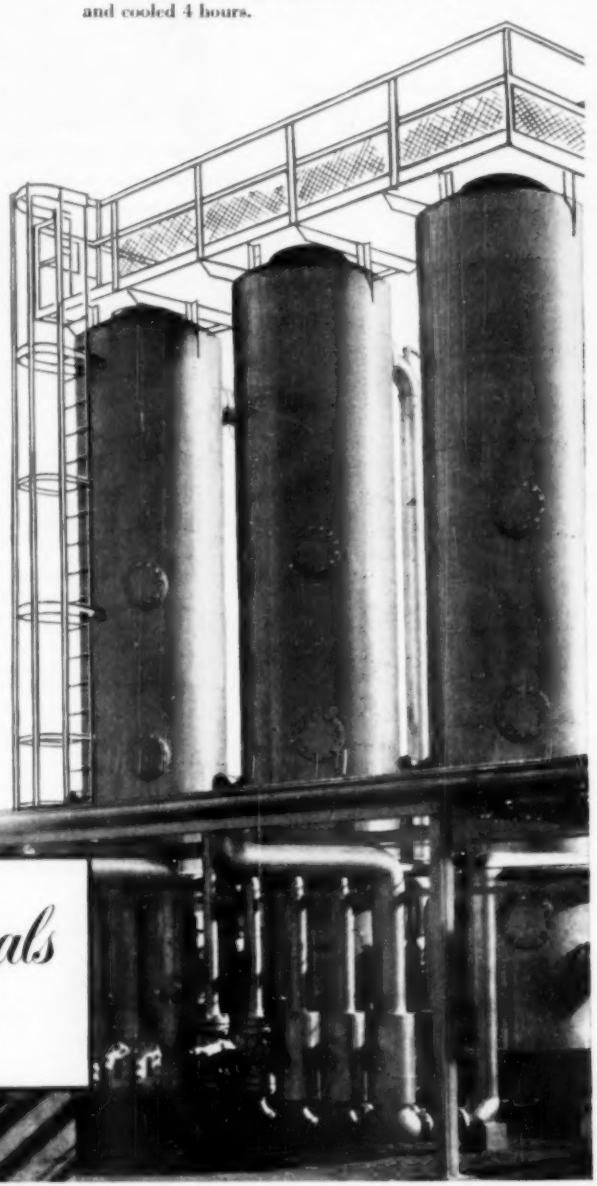
USES ALCOA

ACTIVATED* ALUMINA

IN AUTOMATIC

3-TOWER DEHYDRATOR

Gulf Oil Corporation's 3-tower dehydrator unit at Eunice Gasoline Plant, Eunice, New Mexico. Drying 32,000,000 standard cubic feet of residue gas per day to dew points *well below 0° F.*, the unit permits each tower to be on stream 4 hours, reactivated 4 hours and cooled 4 hours.



This unique 3-tower dehydrator unit is entirely automatic, except for an occasional dew point check.

In such a system, the *reliability* of the desiccant is highly important—a good reason for choosing ALCOA *Activated* Alumina. It is one of the few solid-type drying agents that will not change its form or properties. It will not swell, soften or disintegrate even when immersed in water.

ALCOA *Activated* Alumina is non-corrosive and practically iron-free. It is not affected by shock or abrasion, and has no effect on the end product even when the two stand in contact for long periods. It is a uniformly pure desiccant that dries liquids and gases to a lower dew point than any other commercial adsorbent.

Let us send you the booklet "Activated Alumina—Its Properties and Uses." Its 48 illustrated pages describe the properties and applications of ALCOA *Activated* Alumina. Write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 616L Gulf Building, Pittsburgh 19, Pa.

Reg. T. M., Aluminum Company of America

Alcoa Chemicals

ALCOA ALUMINAS and FLUORIDES

ACTIVATED ALUMINAS • CALCINED ALUMINAS • HYDRATED ALUMINAS • TABULAR ALUMINAS • LOW SODA ALUMINAS ALUMINUM FLUORIDE • SODIUM FLUORIDE • SODIUM ACID FLUORIDE • FLUORIDIC ACID • CRYOLITE • GALLIUM

17. He was associated with both the Avery Chemical Co. and E. M. Hamlin Co. before accepting a commission in the regular Army in 1920.

Catalytic Construction Co. — W. Graham Jamison has been elected vice-president and will continue as company treasurer. He has been treasurer since the company's formation and was formerly assistant to the comptroller of Sun Oil Co. Mr. Jamison is a graduate of Wharton School, University of Pennsylvania.

The Weatherhead Co.—A. D. Hodge has been appointed sales manager of the company's newly formed industrial sales division. A new and carefully planned sales and service has been formulated for the new division handling the complete Weatherhead industrial line. Under the new program the industrial salesmen are strategically located in key cities to render the most efficient service possible and to establish closer contact with the accounts from coast to coast.

Kennedy Valve Manufacturing Co. —Shelby Herron, of Houston, Texas, has been sales representative for the state of Texas. Before joining the Kennedy organization, Herron was in sales engineering work in the oil field supply business. He will handle sales for the complete Kennedy line of bronze and iron-body valves, waterworks valves and fire hydrants, malleable iron, bronze and cast iron fittings.

Cooper-Bessemer Corp. — Clayton L. McDougall has been made sales and engineering representative at the Odessa, Texas, office, where his duties will be concentrated on gas and diesel engines, engine-driven compressors, and liquid pumps for petroleum processing and transmission service.

Mathieson Hydrocarbon Chemical Corp.—L. E. Russell has been appointed director of market development. Prior to his transfer to this new company, Mr. Russell was manager of product development for Mathieson Chemical Corp., which firm he joined in 1941 as a research assistant.

Edward Valves, Inc. — Carl W. Nedderman has been elected assistant vice president. He will be responsible for budgets, financial and accounting, and cost department operations.

Foster Wheeler Corp.—E. F. Wentworth, Jr., has been appointed head of the legal department as general attorney. Mr. Wentworth has been with Foster Wheeler since April 1941, and for twelve years prior was engaged in general and patent law practices in New York and Newark, N. J.

Atlas Mineral Products Co.—George Gabriel, former plant engineer of the Mertztown, Penna., plant, has been promoted to assistant plant practices manager. Robert P. Desch has joined the company as a research chemist. Mr. Gabriel received his B.S. degree in chemical engineering from Pennsylvania State College. Mr. Desch graduated from Muhlenberg with a B.S. degree in 1948 and received a Master's degree from Williams College in 1950.

Calumet and Hecla Consolidated Copper Co.—Horace Y. Bassett, with the Wolverine Tube Co. since 1939, has been elected to the board of directors to fill the vacancy resulting from the death of Dudley S. Dean. He was made general manager of the Wolverine Tube Division of Calumet and Hecla in 1944.

Crane Co.—J. W. Greene has been appointed to the newly created position of assistant manager of the Valve & Fitting Department. His most recent post with the company was sales manager of the New York branch. He will be located at headquarters in Chicago.

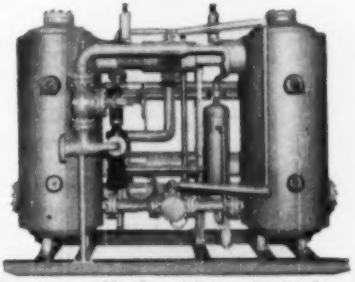
Foster D. Snell, Inc.—Lyman H. Allen, Jr., has been named chief engineer, with headquarters in the New York offices. He was formerly assistant chief design engineer in charge of chemical process design with American Viscose Corp. in Philadelphia.

Air Reduction Co., Inc.—Dr. E. R. Blanchard, who joined the firm in 1946 following work with the Manhattan Project, has been appointed assistant manager of the research division.

Pittsburgh Plate Glass Co. — Dr. Franlin Strain has been made acting director of research in charge of the Columbia Chemicals Division Laboratories at Barberton, Ohio.

Byron Jackson Co.—W. S. Thomas, with the company since July, 1941, has been appointed branch manager of the Houston office of the pump division. Prior to this appointment he was branch manager of the San Francisco office.

Black, Sivalls & Bryson, Inc. — Kenneth W. Lineberry, member of the board of directors since 1946, has been elected president after serving as chief executive officer for the past few weeks. He replaces A. J. Smith, former president and direc-



Install the New Pritchard HYDRYER*...

...for Dependable Dehydration of Air and other Gases

Unexcelled for efficiency in drying air for instrument and process controls. Pritchard HYDRYERS are standard packaged units designed to reduce dew points of compressed air and other gases to minus (–) 40° F. Only service connections are required. Specially designed HYDRYER* units can be built to your requirements.

Write for FREE Bulletin No. 16.0.080 *Registered Trade Name

EQUIPMENT DIVISION
J.F. Pritchard & Co.
Dept. No. 71 908 Grand Ave., Kansas City 6, Mo.

District Offices:
HOUSTON • ST. LOUIS • CHICAGO • PITTSBURGH • TULSA • NEW YORK
Other Representatives in Principal Cities from Coast to Coast.

tor, who has resigned. Mr. Lineberry has announced his resignation as vice-president and director of the F. S. Yantis Co., Chicago, with which firm he has been associated for the past 17 years.

Edward Valves, Inc.—Laurence H. Carr, a member of the technical staff since 1936, has been named director of engineering and research.

Ercona Corp., New York, has been appointed exclusive American agents for the entire line of **Carl Zeiss**, Jena optical instruments, binoculars and photographic lenses. The company has set up a scientific instrument division under the direction of Alfred Boch, formerly with E. Leitz of Wetlar and Fellow of the Royal Microscopical Society.

Weston Electrical Instrument Corp.—James J. Hagan, with the company since 1942, has been appointed assistant plant manager. He joined them as a time study engineer.

American Meter Co.—John C. Diehl, with the company since 1919 and former vice president, has been elected president by the company's board of directors. Norton McKean, president since 1941, has resigned due to his health.

Branches, Distributors

Pyrene Mfg. Co., Newark, N. J., has appointed **Stentz Equipment Co.**, 5605 East Admiral Place, Tulsa, Okla., to handle the engineering and sales of Pyrene air foam fire protection systems to the oil industry. With branch offices in Houston and Dallas, Texas, the Stentz organization will serve throughout the states of Texas, New Mexico, Oklahoma, Kansas, Arkansas, Nebraska, Colorado, Wyoming, Montana, Missouri, South Dakota, western North Dakota, and western Louisiana.

Cambridge Wire Cloth Co., Cambridge, Maryland, has announced the appointment of the following distributors for its line of Gripper Woven Wire Slings:

Auto Electric & Carburetor Co., Inc., Birmingham 3, Ala.; Engineering Factors Co., Avon, Conn.; The Alfred B. King Co., New Haven 3, Conn.; Mechanical Handling Devices, South Bend 1, Ind.; J. M. Farrell, New Orleans 15, La.; Material Handling Equipment Co., Flushing, Mich.; Clark Materials Handling Co., Harrisburg, Penna.; Colonial Supply Company, Pittsburgh 22, Penna.; The Bittenbender Co., Scranton 2, Penna.; L. H. Lantz & Associates, Williamsport, Penna.; Mahoney-Clarke, Inc., New York 7, N. Y.; Mid-State Contractors Equipment Co., Inc., Syracuse, N. Y.; Tidewater Supply Co., Inc., Norfolk 1, Va.; Banks-Miller Supply Co., Huntington 6, W. Va.; and R. D. Travers Co., Hamilton, Ontario, Canada.

De Laval Steam Turbine Co., Trenton, N. J., has appointed the **R. M. Sorlie Co.**, Kalamazoo, Mich., as sales representative. **Robert F. Curray** has been appointed to the company's Detroit office. The Sorlie Co. will handle De Laval sales in the western half of the lower Michigan peninsula. Both the new offices will handle the full line of IMO-De Laval pumps, worm and herringbone gear speed reducers, and couplings.

General Power Plant Corp., manufacturers of Robot-Eye Complete Combustion Controls, have appointed the **Spurgeon Co.** exclusive sales agents in the lower Michigan peninsula area. Spurgeon Co. has its headquarters at 23501 Hoover Rd., Van Dyke, Michigan. **The Stephan Co.**, 7016 Euclid Ave., Cleveland, Ohio, have been appointed exclusive agents for the Ohio area.

LUBREX 45

has ideal melting point for greases and harder soaps

44.0-46.0°C

LUBREX 45

TITRE....(111.2-114.8°F)

Color 5¼" Lovibond Column (max.) 35 Yellow—8 Red			
Iodine Value (Wijs)	25	—	35
Free Fatty Acid (as oleic)	100	—	104%
Acid Number	199	—	206
Saponification Value	202	—	209

HARDESTY FATTY ACIDS

RED OIL • GLYCERINE • STEARIC ACID • WHITE OLEINE • HYDROGENATED FATTY ACIDS • STEARINE PITCH • ANIMAL & VEGETABLE FATTY ACIDS • PALMITIC ACID

Lubrex 45, a product of Hardesty research, fits the demand for a polyunsaturate-free fatty acid especially designed for soap and lubricating grease manufacture. The fatty acids in Lubrex 45 are stabilized in our new hydrogenation unit, to give them a greater resistance to heat discoloration. Freedom from polyunsaturated fatty acids prevents rancidity or gum formation from excess unsaturation. No highly unsaturated acids remain to act as agents for polymerization. The melting point of Lubrex 45 has been accurately controlled to give the optimum possible degree of hardness for your precise requirements. Color and uniformity are strictly maintained. Write for details.

Send for new Hardesty 24-page Fatty Acid Specification Catalog

H. C. HARDESTY CO., INC.

HARDESTY PRODUCTS ARE INDUSTRY'S KEYSTONE

Established 1926

41 EAST 42nd STREET, NEW YORK 17, N. Y.

Factories: Dover, Ohio
Los Angeles, Calif. • Toronto, Can.

Many Subjects Pertinent to Petroleum On Program of Annual ASME Meeting

TOPICS of both direct and indirect interest to petroleum processing engineers on the program of the annual meeting of the American Society of Mechanical Engineers at the end of this month include instruments, pumps, heat transfer, fuels, lubricants, air pollution, pressure vessels, packing and gaskets, effects of temperature on metals, and the like.

This 71st annual meeting of the Society, to be held at the Statler Hotel in New York City, November 26-December 1, is expected to attract 7500 to its 83 sessions comprising more than 200 papers. Of the complete program, approximately 43 papers, plus three symposiums, in 18 different sessions, are of value to oil industry engineers.

The attack on metals and tube fouling effects of burning heavy fuel oils is one problem to be discussed in a fuel section symposium. Another panel will explore what is wrong with the way fuels and fuel utilization are taught in schools and in industry.

One long evening session of six papers will be devoted to the effects of high temperatures on steels and alloys. Pump problems as related to pump impellers performance are scheduled for one session of three papers. In addition, there will be an afternoon round table on cavitation.

Fluid meters will be the subject of three sessions consisting of eight papers as part of the Industrial Instruments and Regulators Division of ASME portion of the meeting. A separate session of three papers will be centered on control instruments.

Concurrently with the Society meeting, the 19th National Exposition of Power and Mechanical Engineering will be held at Grand Central Palace, November 27-December 2, under the auspices of the ASME.

A portion of the annual meeting program, indicating those papers that might be of value to petroleum men, follows:

Monday, November 27, 9:30 a.m.

FLUID METERS

Pressure-Temperature Relations in Gas-Filled (Class III) Thermometers, E. E. Modes, J. P. Marsh Corp.

Precision and Accuracy of Orifice-Meter Installations, L. V. Cunningham, Esso Standard Oil Co., Louisiana Division.

Pitot-Venturi Flow Element, Henry W. Stoll, Taylor Instrument Cos.

Monday, November 27, 2:30 p.m.

HYDRAULICS

Measured Performance of Pump Impellers, W. C. Osborne and D. A. Morelli, California Institute of Technology.

A Method for Calculating the Degree of Flow Deviation at the Discharge of Centrifugal Pump Impellers, W. C. Osborne, California Institute of Technology.

Evaluation of the Quality of a Pump Impeller, D. A. Morelli and J. H. Beveridge, California Institute of Technology.

FLUID METERS

Study of Linear Resistance Flowmeters, F. W. Fleming, Jackson, Miss., and R. C. Binder, Purdue University.

Orifice Meters with Supercritical Compressible Flow, R. G. Cunningham, Pure Oil Co.

Discharge Coefficients of Small Diameter Orifices and Flow Nozzles, H. P. Grace and C. E. Lapple, E. I. du Pont de Nemours & Co., Inc.

Monday, November 27, 8:00 p.m.

STEAM-JET COMPRESSORS

Effect of Molecular Weight of Entrained Fluid on the Performance of Steam-Jet Ejectors, William C. Holton, Battelle Memorial Institute.

Effect of Temperature of Entrained Fluid on the Performance of Steam-Jet Ejectors, William C. Holton and E. V. Schulz, Battelle Memorial Institute.

Measurement of Flow Rate in Saturated Air Tests for Steam-Jet Ejectors, R. C. Binder, Purdue University.

Tuesday, November 28, 9:30 a.m.

HEAT TRANSFER

Heat and Momentum Transfer through Steam in Plain and Modified Annuli, G. W. Govier and R. R. White, University of Michigan.

Heat Transfer to a Fluid Flowing Turbulently in a Smooth Pipe with Walls at Constant Temperature, R. A. Seban, University of California, and T. Shinazaki.

The Precise Measurement of Temperature as an Aid to the Study of Heat Transfer, H. D. Baker, Columbia University and Pratt & Whitney Aircraft Div., and E. A. Ryder, Pratt & Whitney.

Theory of the Oil Cooler; Heat Exchange and Pressure Drop in Slots with Parallel Walls at Variable Viscosities, H. Schuh.

Tuesday, November 28, 9:30 a.m.

INSTRUMENTS & REGULATORS

Nondimensional Study of Proportional-Plus-Reset Control of a Single Capacity System, J. A. Hrones and J. B. Reswick, Massachusetts Institute of Technology.

Controller Settings for Optimum Control, W. A. Wolfe, University of British Columbia.

An Improved Pneumatic Control System, R. E. Clarridge, Taylor Instrument Cos.

Tuesday, November 28, 2:30 p.m.

HYDRAULICS

Round Table Discussion on Cavitation, moderator, R. T. Knapp.

Tuesday, November 28, 8:00 p.m.

FUELS

Panel: Problems Encountered in Burning Heavy Fuel Oil as Related to Attack of Metals at High and Low Temperature and the Fouling of Tube Banks: O. L. Wood, Jr., General Electric Co.; E. F. Tibbetts, Lummus Co.; V. F. Estcourt, Pacific Gas and Electric Co.; Dwight Douglas, Hartford Electric Light Co.

FLUID METERS

A Study of Heat Loss in Venturi Meter-Diffuser Sections, Joel Warren, Brown University.

Discharge Measurements by Means of Venturi Tubes, A. L. Jorissen, Pennsylvania State College.

Thursday, November 30, 9:30 a.m.

FUEL EDUCATION SYMPOSIUM

What Engineering Schools Should Teach About Fuels and Fuel Utilization, A. A. Potter, Purdue University.

How Industry Can Cooperate with and Assist Engineering and Technical Schools in Offering Instruction in Fuels and Fuel Utilization, W. E. Reuser, Swarthmore College.

What Is Being Done Today on Instruction in Fuel Utilization for Engineering Schools? C. C. Wright, Pennsylvania State College.

On-the-Job Training Programs and Fuel Utilization, R. J. Brandon, Detroit Edison Co.

Thursday, November 30, 2:30 p.m.

HEAT TRANSFER

Expansion Joints for Heat Exchangers, M. F. Sayre and S. Kopp, Alco Products Div., American Locomotive Co.

Aluminum Alloys in Heat Exchanger Construction, E. G. Kort and J. S. Hamilton, Aluminum Co. of America.

A Leak Proof Heat Exchanger, J. T. Cullen, General Electric Co.

Thursday, November 30, 8:00 p.m.

TEMPERATURE EFFECTS

An Introduction to Arc-Cast Molybdenum and Its Alloys, J. L. Ham, Climax Molybdenum Co.

Experience with Austenitic Steels in High Temperature Service in the Petroleum Industry, M. E. Holmberg, Phillips Petroleum Co.

An Investigation of the Role of Aluminum in the Graphitization of Plain Carbon Steel, A. M. Hall and E. E. Fletcher, Battelle Memorial Institute.

Cast Nickel-Chromium Molybdenum Valve Steel Casting after 50,000 Hours Service at 900° F., T. N. Armstrong and R. J. Greene, International Nickel Co.

Creep and Creep-Rupture Testing of Steam Boiler Materials, J. B. Romer and D. H. Newell, Babcock & Wilcox.

The General Relaxation Properties of a Bolting Steel, Donald Frey, University of Michigan.

Friday, December 1, 9:30 a.m.

PETROLEUM BOILER CODE

Effects of Internal Pressure on Stresses and Strains in Bolted Flanged Connections, D. B. Wesstrom and S. E. Bergh, E. I. du Pont de Nemours & Co., Inc.

A Design Procedure for Integral Flanges with Tapered Hubs, W. F. Jaep, E. I. du Pont de Nemours & Co., Inc.

Formula for Pipe Thickness, W. J. Buxton and W. R. Burrows, Standard Oil Co. (Indiana).

Friday, December 1, 2:30 p.m.

AIR POLLUTION

Background of Present Smoke Regulation Ordinances, J. F. Barkley, chief, Fuels Utilization Division, U. S. Bureau of Mines.

Present Status of Air Pollution Control, H. P. Munger, Battelle Memorial Institute.

MEETINGS . . . for the Oil Man

NOVEMBER

14-15, American Society for Testing Materials, Committee D-20 on Plastics, Cincinnati, Ohio.

26-Dec. 1, American Society of Mechanical Engineers, Annual Meeting, Hotel Statler, New York.

27-Dec. 2, 19th Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.

DECEMBER

3-6, American Institute of Chemical Engineers, 43rd Annual Meeting, Neil House, Columbus, Ohio.

8, Natural Gasoline Association of America, Regional Meeting, Herring Hotel, Amarillo, Texas.

28-29, American Chemical Society, Div. of Industrial and Engineering Chemistry, Christmas Symposium, Baltimore, Md.

JANUARY, 1951

8-12, Society of Automotive Engineers, Annual Meeting and Engineering Display, Book-Cadillac Hotel, Detroit.

15-18, Second Plant Maintenance Conference and Show, Public Auditorium, Cleveland.

19, American Chemical Society, New York section, Symposium on Radioisotopes, Hotel Statler, New York.

FEBRUARY

23, Natural Gasoline Association of America, Regional Meeting, Settles Hotel, Big Spring, Texas.

28-March 2, Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, William Penn Hotel, Pittsburgh.

MARCH

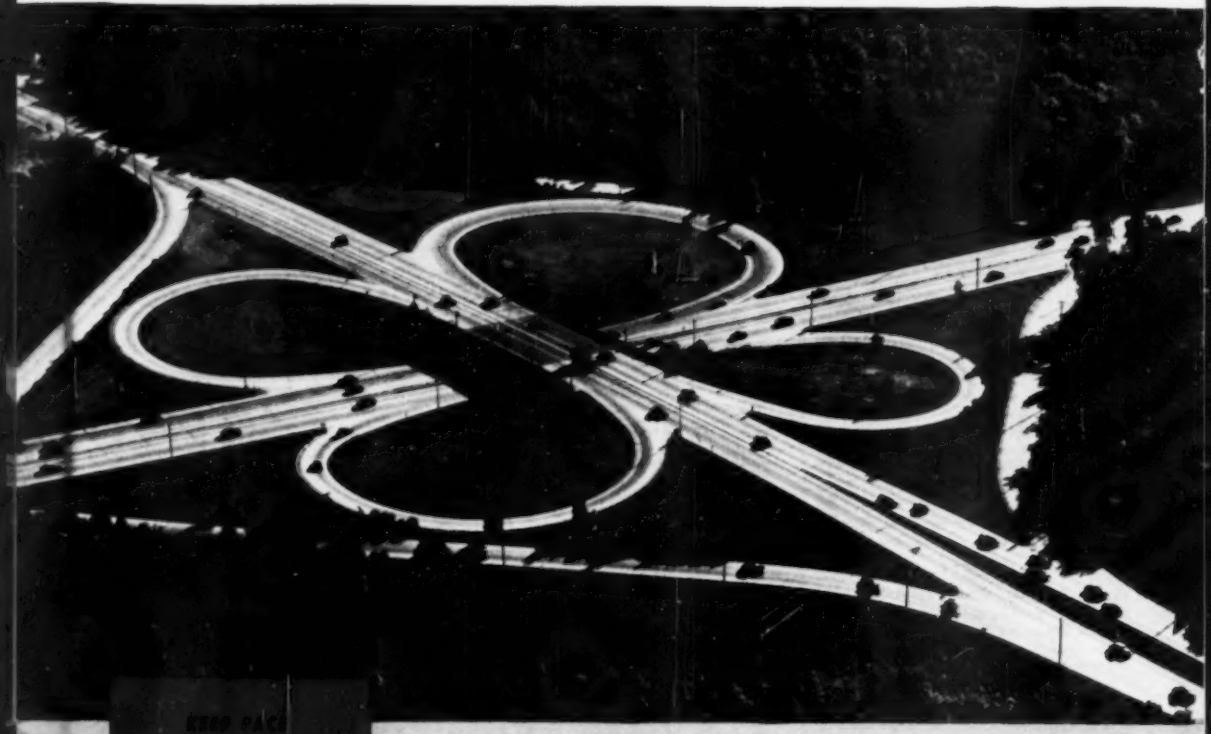
5-9, American Society for Testing Materials, Spring Meeting and Committee Week, Cincinnati, Ohio.

11-14, American Institute of Chemical Engineers, Regional Meeting, The Greenbrier, White Sulphur Springs, W. Va.

12-16, First South American Oil Congress, Montivideo, Uruguay.

13-16, National Association of Corrosion Engineers, Annual Conference and Exhibition, Hotel Statler, New York.

Compare YOUR REFINERY MANIFOLDS WITH TRAFFIC CONTROLS



MANIFOLDS—The traffic center of a refinery—are the arteries of flow that should be given first attention in a well-planned policy of valve replacements. By installing Nordstroms you avoid the possibility of mixing because a Nordstrom insures the most positive and complete shut-off. The more Nordstroms on a manifold, the faster the switching. Instead of taking an hour or more to turn a battery of conventional-type valves on or off, your operator can do it in a matter of minutes with Nordstroms.

TRAFFIC CONTROL is undergoing revolutionary changes in all principal American cities to avoid congestion and accidents and to save motorist's time. ☆ Cost-conscious refinery engineers are also adopting the sound plan of progressively replacing troublesome valves with Nordstroms to gain improved flow control.

ADOPT THIS GOOD HABIT—replace worn-out valves with Nordstroms. Be sure your requisition specifies Nordstrom. This will give you a good opportunity to *compare* Nordstrom performance with other valves on the same service. Eventually your manifolds will be completely modernized—for improved flow control, safer operation and faster manipulation. The cost of replacing with Nordstroms is competitive with conventional valves.

ADOPT THE PROGRESSIVE HABIT...REPLACE OLD VALVES WITH NORDSTROMS

Modernize your Manifolds with

Nordstrom Valves

NOW AUTOMATICALLY LUBRICATED WITH Hypermatic

TRADE MARK

PATENTS APPLIED FOR

ROCKWELL MANUFACTURING COMPANY

400 North Lexington Avenue • Pittsburgh 8, Pennsylvania

Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa . . . and leading Supply Houses. Export: International Division, Rockwell Manufacturing Company, 7701 Empire State Bldg., New York 1, N. Y.

BOOKS

Union Oil Co. History Tells Vivid Story of Oil Industry

Black Bonanza, by Frank J. Taylor and Earl M. Welty; 7 x 10 in., 280 pages, illustrated, stiff cloth binding. $4.00. Whittlesey House, McGraw-Hill Book Co., 330 West 42nd. St., New York 18, N. Y.

As part of its 60th anniversary celebration, Union Oil Co. of California commissioned two veteran newspapermen to write a book on the company's history. *Black Bonanza* is the result of 18 months of 18-hour days spent at research and writing.

Although the book was conceived as a house project, its value and interest extend beyond Union Oil because the history of the petroleum industry, from Titusville to the present, is woven into Union Oil's own story. "Union Oil is a fair cross section of the industry as a whole," the authors wrote. "Union is unique in that because of the pioneering of one of its founders, Lyman Stewart, in Pennsylvania, it bridges the complete life span of the oil business. Third-generation Stewarts are still key figures in Union."

The book captures the lusty spirit of the brawling decades. Because of the brisk style, it is easy for a reader to push through the teeming facts and historical data to glean information of particular interest. Interest and value are enhanced by some 196 illustrations.

Black Bonanza serves a three-fold mission. It supplies Union Oil with a complete historical account between two covers, something few, if any, other oil companies have. It can be used advantageously as a public relations and publicity device.

Third, it contains a subtle message on free enterprise that is effective because it's part of the story. Chapter four relates the financial setbacks, dry holes, desperation, adamant creditors, and heartbreaks Lyman Stewart and Wallace Hardison experienced before their courage, pertinacity, integrity, and capability enabled them to convert a borrowed shoestring to the Union Oil Co.

Chapter four could well be required reading for those so ready to impugn free enterprise and the oil industry.

Until the company became firmly established, there was a succession of struggles: first, to find oil; next, the obstacles met in trying to develop products; then, the internal warring factions and, finally, resistance against larger companies trying to gobble up the juicy, new tidbit of a company.

Mr. Taylor, one-time war correspondent and United Press reporter, has been a prominent free-lance correspondent for years, contributing to *Saturday Evening Post*, *Country Gentleman*, and *Reader's Digest*. Mr. Welty, who has contributed articles to *Harper's*, *Collier's*, *Scribner's*, and *Nation's Business*, has been a newspaper editor for over 20 years. They pored over hundreds of thousands of words of documents and records, interviewed hundreds of persons gathering and processing the material.—Frank Breese, West Coast Correspondent, *National Petroleum News*.

New Type Engineers' Manual Published for the First Time

Plant Engineering Handbook, William Staniar, Editor-in-Chief; 6 x 9 in., xv + 2007 pages, fabrikoid type binding, illustrated, indexed, $15.00. McGraw-Hill Book Co., 330 West 42nd St., New York 18, N. Y.

The *Plant Engineering Handbook* is another volume in the publishers' Industrial Organization and Management Series and, indeed, has value to the management level of industrial business enterprise. However, it is also a book that can well take its place on the desk alongside such standard technical references as Perry's *Chemical Engineers' Handbook*, Marks' *Mechanical Engineers' Handbook*, and many others.

It was written for those people in all industries who are responsible for organization, design, construction, operation, and maintenance. "Experience over the years has shown the need for a book that could be used to solve the day-to-day problems of industry," the author states in his preface. "This book is a compendium of industrial know-how and presents in compact form material that appears in greater detail in specialized reference works. It is not intended to replace the usual type of engineering handbook; it is to supplement and extend."

The book is organized in 35 sections covering such subjects as basic costs and cost reduction, materials of construction, fire protection, water treatment, instrumentation and control, piping, welding, power plants and power transmission, lubrication, packings, materials handling, metallurgy and corrosion, waste disposal, heat transfer, graphical mathematics, plastics, patents and copyrights.

Forty-six industrial corporations and six universities are represented by the 86 contributors to the book. Editor-in-chief William Staniar, until his retirement in 1946, was associated with E. I. du Pont de Nemours & Co. for 42 years. As mechanical power engineer (1921-1946) in charge of all mechanical power installations in 85 plants, he designed numerous complicated installations. He also originated the power belting standardization system used in all the large plants of du Pont and in four of the largest units of the General Motors Corp. He has published two books on mechanical power transmission, and has contributed the mechanical power section in the *Encyclopedia Britannica* (14th Edition).

1950 Tentative Fire Ordinance On Flammable Liquids Offered For Comments

The National Fire Protection Association has just published in pamphlet form the "1950 Tentative Suggested Ordinance for the Storage, Handling and Use of Flammable Liquids," NFPA No. 30-L-TR.

A wide distribution is desired by the Association, particularly among petroleum people, to secure comments and suggestions for changes and improvements in this tentative ordinance. Such suggestions should be submitted to NFPA by January 1, 1951, so as to receive proper Committee consideration.

Readers may obtain copies of the pamphlet at 50c each by writing the National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass.

CNGA Publishes Tentative Standard on Natural Gas

Tentative Standard Procedure for the Determination of Carbon Dioxide and Oxygen in Natural Gases, California Natural Gasoline Association Bulletin TS-501; 9 x 11½ ins., 13 pages including index and committee personnel, illustrated, paper binding. $2 to CNGA members, $2.50 to non-members. CNGA, 510 West Sixth, Los Angeles 14, Calif.

This bulletin presents a tentative standard procedure for determining CO_2 and O_2 in natural gases, and is intended as an operating manual for the analyst both in the laboratory and in the field. While it makes use of the well-known Orsat test, there are many variations in apparatus and application, which CNGA now has reduced to a standard in apparatus and procedure.

Recognizing that the same degree of accuracy is not required generally for field work as it is in the laboratory, the bulletin is divided into two sections. The first procedure covers laboratory installations where accuracy is the prime requisite. The alternate procedure for field and plant work covers apparatus which must be portable and rugged. Both procedures make use of the same general principle of absorption of the two gases in separate pipettes and generally are applicable to natural gases.

Where hydrogen sulfide is present, the procedure calls for absorbing it in CO_2 and determining it separately

by CNGA Tentative Standard Method, Bulletin TS-431. Nitrogen cannot be determined except as it occurs in the air. The accuracy of the method is predicated on testing gases free from entrained liquids or liquids condensing at test conditions of temperature and pressure. If such liquids are present, appropriate means must be taken for their removal or their effect on the results eliminated in some manner.

Article Collection Describes Modern Chemical Processes

Modern Chemical Processes, a series of articles; 8½ x 11¼ in., 222 pages, indexed, illustrated, stiff cloth binding, $4.00. Reinhold Publishing Corp., 330 W. 42nd St., New York 18, N. Y.

This book is a collection of 23 articles describing various chemical manufacturing plants and processes. Although not brought out too clearly in the foreword to the book or elsewhere, it is a reprint of material previously published in *Industrial and Engineering Chemistry*.

Only five of the articles are of direct or even indirect interest to most petroleum technologists. One deals with the manufacture of paving asphalt from California crude, and a second with the Bureau of Mines' work on coal hydrogenation. The other three deal with synthetic methanol from natural gas, low temperature synthetic rubber, and petroleum-base protective coatings.

Government Publications

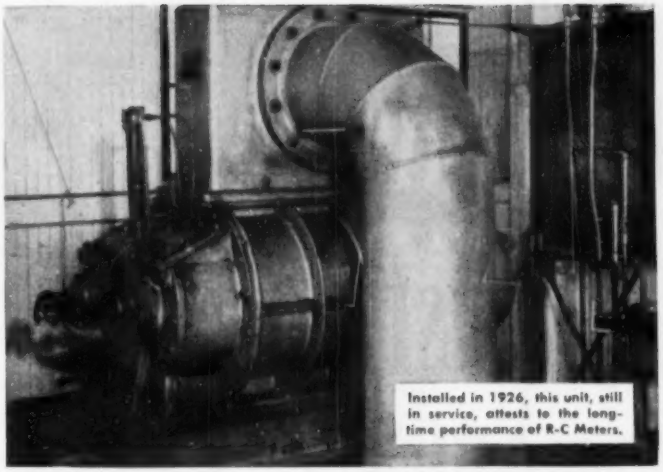
Natural Gasoline and Cycle Plants in the United States, January 1, 1950, Information Circular 7576, July, 1950, by D. S. Colby and E. M. Seeley; Dept. of the Interior, Bureau of Mines; 8 x 10½ in., 17 pages, heavy paper binding.

Development of a Mobile Compressor and Utility Station, Report of Investigations 4709, July, 1950, by Fred D. Wright and Homer J. Ballinger, Dept. of the Interior, Bureau of Mines: 8 x 10½ in., 4 pages, heavy paper binding.

Waxes from Shale-Oil Wax Distillate, Report of Investigations 4708, July, 1950, by P. R. Tisot and Joseph W. Horne, Dept. of the Interior, Bureau of Mines: 8 x 10½ in., 21 pages, heavy paper binding.

Petroleum Refineries, Including Cracking Plants, in the United States, January 1, 1950, Information Circular 7578, by F. S. Lott and J. G. Kirby, Dept. of the Interior, Bureau of Mines: 8 x 10½ in., 19 pages, heavy paper binding.

Order copies of the above booklets from the Bureau of Mines, Publication Office, 4800 Forbes St., Pittsburgh 13, Penna.



Installed in 1926, this unit, still in service, attests to the long-time performance of R-C Meters.

NO PENSION FOR THIS OLD-TIMER
even after *23* years of service

Accurate and dependable as always, this 23-year-old Roots-Connersville Meter still performs faithfully. No retirement for this veteran! Because new demands called for higher capacity, it has been transferred to another job in the same plant. Its old duties have been taken on by a new R-C unit, purchased because of fine performance of this old-timer.

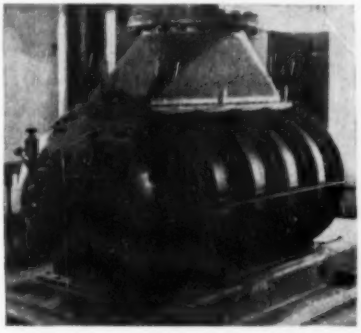
That's a common history of R-C Meters. They're built to measure accurately, and keep on doing it, year after year. Simple design, finely machined measuring surfaces and other important refinements account for their ability to measure gas accurately and unfailingly, almost indefinitely.

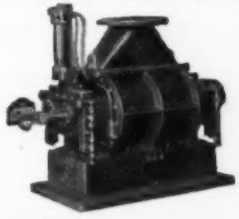
With 31 standard sizes and capacities from 4,000 to 1,000,000 cfh, R-C Meters meet the needs of most applications. Write for Bulletin 40-B-14 or tell us your specific requirements.

ROOTS-CONNERSVILLE BLOWER CORPORATION
511 Texas Avenue, Connersville, Indiana

(Right) This R-C Meter, with capacity of 317,000 cfh, replaced the "old-timer" above, now transferred to other duties.

(Below) Typical small capacity R-C Meter for low and medium pressures.





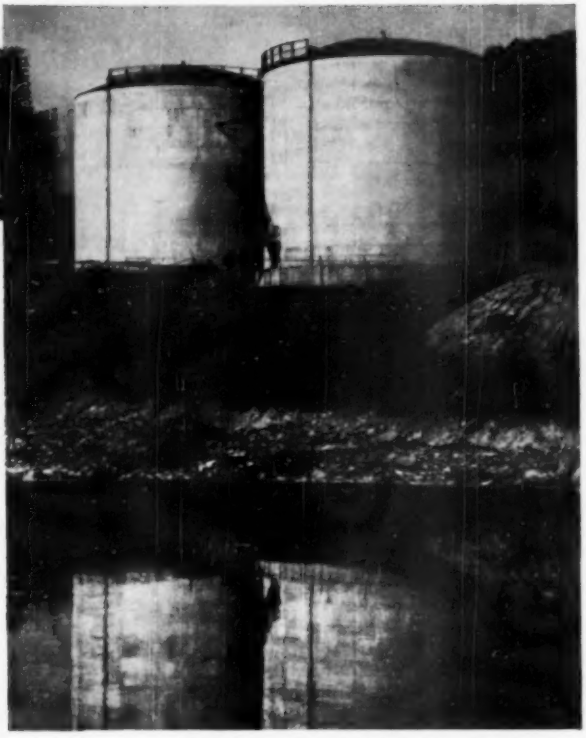
ROOTS-CONNERSVILLE
BLOWER BUILDERS SINCE 1854
ONE OF THE DRESSER INDUSTRIES

[*To obtain more data on advertised products see page* 1236]

specify...

Mathieson Caustic Soda

and you get 3 *all* benefits



Specially constructed liquid caustic storage tanks at Mathieson's Saltville, Virginia plant.

CAPACITY

Mathieson, with its three large plants using both the electrolytic and ammonia-soda processes, is one of the country's largest producers of caustic soda.

DIVERSITY

Mathieson Caustic Soda is available in 50% and 73% liquid form in regular and rayon grades of purity; also in solid and flake form. With Mathieson as your source of supply you are sure of getting any grade you need.

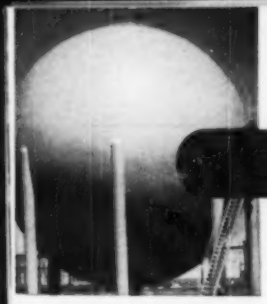
FLEXIBILITY

Mathieson Caustic Soda is produced at three points strategically located to serve economically the principal industrial areas of the country. Write today for our latest handbook on Mathieson Caustic Soda. Mathieson Chemical Corporation, Mathieson Building, Baltimore 3, Maryland.

Mathieson CHEMICALS

0453

SERVING INDUSTRY, AGRICULTURE AND PUBLIC HEALTH



Higher Yields, Larger Volume of Runs Bring Record Output of Heating Oils

OCTOBER operations indicate: Crude runs of around 6,085,000 b/d, slightly higher than the Mines Bureau estimates is required to meet coming winter demands. . . Gasoline stocks start to build up, at higher rate than in October '49. . . Heating oils output highest on record, with indicated distillate yield close to 20%. . . . Imports of residual fuels highest since last winter and early spring.

Crude Runs: The Mines Bureau forecasts crude runs in November of 6,050,000 b/d and states maintenance of runs at "somewhat below current levels" should meet total demand during winter months. This is about in line with statements of oil company executives expressed at the Texas Railroad Commission hearing Oct. 18.

Crude runs to stills in October (6,086,000 b/d) were 713,000 b/d (13.3%) higher than in October, '49. Comparison of crude runs in August, September and October this year with the same period in 1949 shows approximately 200,000 b/d more oil being processed in the East Coast area, about the same amount in the Texas and Louisiana Gulf Coast districts, about 100,000 b/d more in the Ind.-Ill.-Ky district and nearly 70,000 b/d more in California refineries.

The first 9 months of this year total crude runs were around 1,532,400,000 bbls., 5.6% more than was processed in the same period in 1949.

Motor Fuel: Total motor fuel demand in November is forecast by the Bureau of Mines at around 2,883,000 b/d. This is not much less than the indicated demand for October of 2,890,000 b/d. Indicated demand in October was 9.1% above October '49, a higher rate of increase than earlier this year.

Indicated motor fuel supply in October was around 2,915,000 b/d, as compared with the peak output of 2,990,000 b/d in August. The higher rate of production as compared with a year ago (8.6%) is due to the larger volume of crude being processed, the gasoline yield being around 42.5%, as compared with 43.4% in October, 1949, the current figure reflecting the greater attention being given to distillate fuels.

Gasoline stocks, at a little over 105,000,000 bbls. at the end of October, compare with around 103,300,000 bbls. in storage at the end of October, '49.

Heating Oils: Production of fuel oils in October is indicated as 1,210,000 b/d of distillates and 327,000 b/d of kerosine, total of 1,537,000 b/d., the highest on record. The large volume is due to higher yields of distillates as well as increases in crude runs. Indicated distillate yield is 19.9%, which compares with 18.3% yield in October a year ago. In February, 1948, when output of heating oils was a little better than 1,500,000 b/d, less crude was run, but yield on distillates was 20.6% and on kerosine 6.9%.

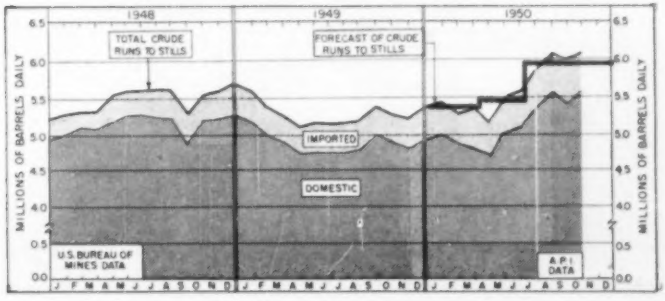
While all refining areas have advanced their yields on distillates, the Oklahoma-Kansas district was producing 22.2% in August, as compared with 18.6% in August a year ago.

The October output of heating oils is nearly 19% higher than a year ago. To meet forecast demand for November through February, with production continued at the October rate, a total draft on stocks of about 42,000,000 bbls. would be required. Actual drafts in the same period last winter were nearly 50,000,000 bbls. Indicated total stocks of kerosine and distillates Oct. 31 were around 113,000,000 bbls., as compared with 118,250,000 bbls. a year ago.

Residual Fuels: October imports, 320,000 b/d, were the highest since last winter and early spring. Indicated rate of supply, 1,525,000 b/d, was the highest on record and refinery output, 1,205,000 b/d, was the highest since early 1949.

Residual stocks east of California are about 1,500,000 bbls. under a year ago. There has been little build-up in California stocks, which were around 15,400,000 bbls. at the end of October, as compared with about 38,000,000 bbls. at the end of October, '49.

Fig. 1, Crude Runs Continue Upward Trend



Crude Runs to Stills

Daily Average (1000 bbls.)

	Domestic	Foreign	TOTAL
October '50 API*	5,607	479	6,086
October '49 BM	4,928	445	5,373
Change	+679	+34	+713
% Change	13.7	7.6	13.3

* Through Oct. 28.

Total (1000 bbls.)
(Bureau of Mines Data)

9 Mo. '50*	1,419,644	120,772	1,532,403
9 Mo. '49	1,337,713	112,733	1,450,446
Change	+64,918	+17,039	+81,957
% Change	4.8	15.1	5.6

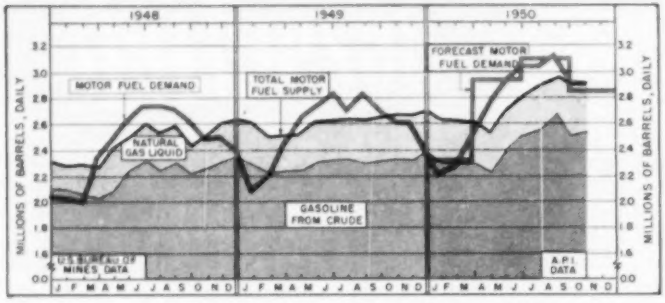
* September from API data.

BM Forecast of Runs to Stills
(1000 b/d avg.—Revised Aug. 28)
3rd Quar., 5,928; 4th Quar., 5,920; 1950, 5,660

Yields on Crude Runs to Stills

	Gasoline %	Kerosine %	Dist. Fuels %	Resid. Fuels %
Oct. '50 API	43.4	6.4	19.9	19.8
Sept. '50 API	42.6	6.6	19.2	19.6
Aug. '50 BM	43.8	6.3	18.1	19.1
Oct. '49 BM	43.4	6.6	18.3	20.9

Fig. 2, Motor Fuel Demand Continues High



Natural Gas Liquids include natural gasoline blended at refineries, and used direct as motor fuel.

Fig. 3, Little Change in Gasoline Stocks in Oct.

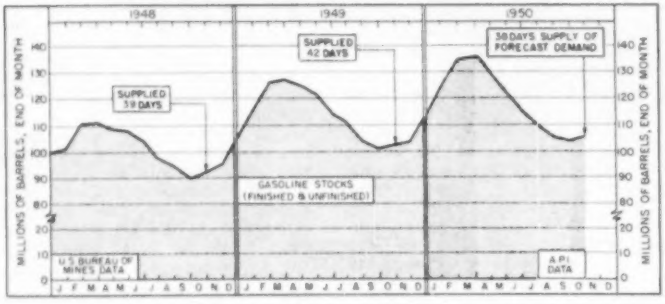

1948
1949
1950
SUPPLIED 39 DAYS
SUPPLIED 42 DAYS
30 DAYS SUPPLY OF FORECAST DEMAND
GASOLINE STOCKS (FINISHED & UNFINISHED)
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, END OF MONTH
J F M A M J J A S O N D

Fig. 4, Heating Oils Output Highest on Record

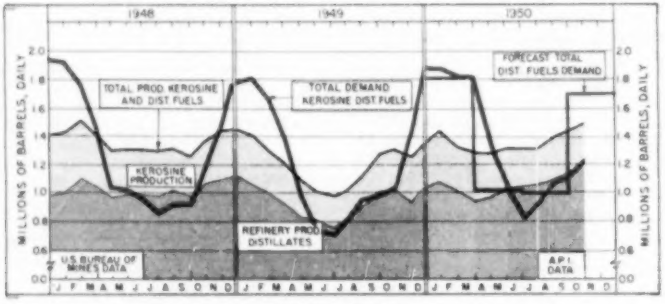
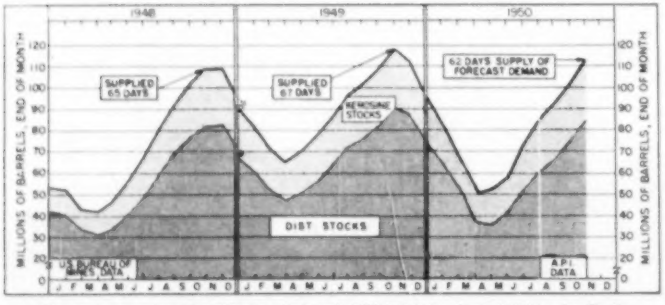


Fig. 5, Heating Oil Stocks Close to '49 Level



* Change in reporting in California eliminated 4,500,000 bbls. from distillate classification.

Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
October '50 API*	2,580	335	2,915
October '49 BM	2,375	308	2,683
Change	+205	+27	+232
% Change	8.6	8.7	8.6

* Through Oct. 28

Total (1000 bbls.) (Bureau of Mines Data)

9 Mo. '50*	666,463	88,262	754,725
9 Mo. '49	635,313	80,035	715,348
Change	+31,150	+8,227	+39,377
% Change	4.9	10.4	5.5

* September from API data

Motor Fuel Demand

Including Exports
Daily Average (1000 bbls.)

October '50 API*	2,890
October '49 BM	2,649
Change	+241
% Change	9.1

* Through Oct. 28

Total (1000 bbls.) (Bureau of Mines Data)

9 Mo. '50*	758,326
9 Mo. '49	714,366
Change	+43,960
% Change	6.1

* September from API data

BM Forecast of Motor Fuel Demand
(1000 b/d avg.—Revised Aug. 28)
3rd Quar., 2,109; 4th Quar., 2,845; 1950, 2,783

Gasoline Stocks

Finished and unfinished, end of month (1000 bbls.)

Oct. '50 API*	107,062
Sept. '50 API	104,583
Aug. '50 BM	107,367
Oct. '49 BM	103,287

* On Oct. 28

Heating Oils Production

(Kerosine and Distillates)
Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
October '50 API*	327	1,209	1,536
October '49 BM	301	1,001	1,302
Change	+26	+208	+234
% Change	8.6	20.8	18.0

* Through Oct. 28

Total (1000 bbls.) (Bureau of Mines Data)

9 Mo. '50*	80,256	292,336	368,022
9 Mo. '49	72,785	247,635	320,420
Change	+13,791	+34,721	+48,512
% Change	18.9	14.0	15.1

* September from API data

Heating Oils Demand

Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
October '50 API*	300	948	1,248
October '49 BM	271	773	1,044
Change	+29	+175	+204
% Change	10.7	22.6	19.5

* Through Oct. 28

Total (1000 bbls.) (Bureau of Mines Data)

9 Mo. '50*	79,423	283,696	363,119
9 Mo. '49	70,076	239,249	309,325
Change	+9,347	+44,447	+53,794
% Change	13.3	18.5	17.4

* September from API data

BM Forecast of Heating Oils Demand
(1000 b/d avg.—Revised Aug. 28)
3rd Quar., 1027; 4th Quar., 1761; 1950, 1408

Heating Oil Stocks

(1000 bbls. end of month)

	Kerosine	Dist. Fuels	TOTAL
Oct. '50 API*	28,034	84,057	112,091
Sept. '50 API	27,849	76,734	104,583
Aug. '50 BM	25,803	68,426	94,229
Oct. '49 BM	27,609	90,643	118,252

* On Oct. 28

Fig. 6, Refinery Output of "Resids" Increasing

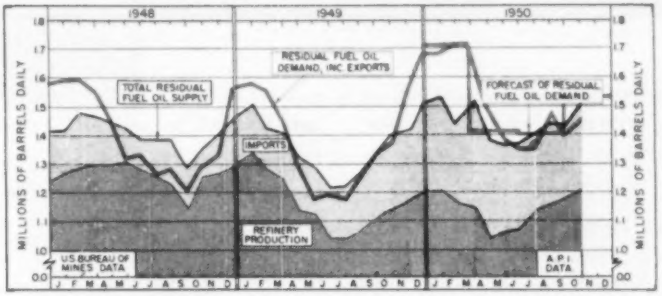
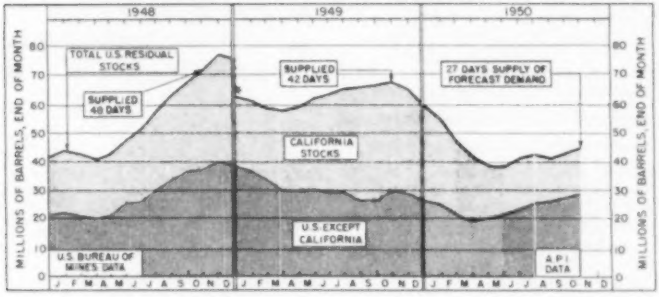


Fig. 7, Small Gain in Residuals Stocks



* Change in reporting in California eliminated 13,000,000 bbls. from residual classification.

Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Output	Imports	TOTAL
October '50 API*	1,205	320	1,525
October '49 BM	1,141	264	1,405
Change	+64	+56	+120
% Change	5.6	21.2	8.5

* Through Oct. 28

Total (1000 bbls.) (Bureau of Mines Data)

9 Mo. '50*	308,893	82,586	391,479
9 Mo. '49	316,774	49,003	365,777
Change	−7,881	+33,583	+25,702
% Change	2.5	68.5	7.0

* September from API data.

Residual Fuels Demand

Daily Average (1000 bbls.)

October '50 API*	1,455
October '49 BM	1,365
Change	+90
% Change	6.6

* Through Oct. 28

Total Demand (1000 bbls.)

9 Mo. '50*	413,283
9 Mo. '49 *	366,473
Change	+46,810
% Change	12.8

* September from API data.

BM Forecast of Residual Fuel Demand
(1000 bbl. avg.—Revised Aug. 28):
3rd Quar., 1,405; 4th Quar., 1,534; 1950, 1520

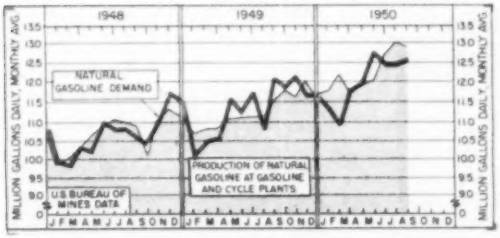
Residual Fuel Stocks

(1000 bbls. end of month)

	U.S. Except California	Total U.S.
Oct. '50 API*	28,931	44,310
Sept. '50 API	28,196	42,530
Aug. '50 BM	26,648	40,979
Oct. '49 BM	30,551	68,673

* On Oct. 28

Fig. 8, Production and Demand of Natural Gas Liquids


1948
1949
1950
MILLION GALLONS DAILY MONTHLY AVG.
NATURAL GASOLINE DEMAND
PRODUCTION OF NATURAL GASOLINE AT GASOLINE AND CYCLE PLANTS
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D

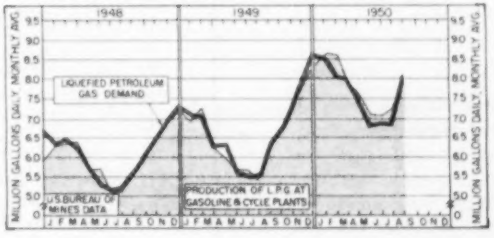
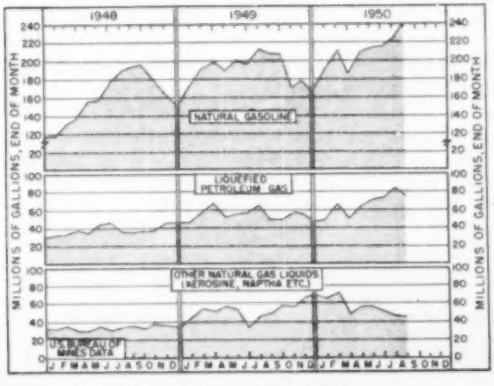

1948
1949
1950
MILLION GALLONS DAILY MONTHLY AVG.
LIQUEFIED PETROLEUM GAS DEMAND
PRODUCTION OF L.P.G. AT GASOLINE & CYCLE PLANTS
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D

Fig. 9, Stocks of Natural Gas Liquids


1948
1949
1950
MILLIONS OF GALLONS, END OF MONTH
NATURAL GASOLINE
LIQUEFIED PETROLEUM GAS
OTHER NATURAL GAS LIQUIDS (KEROSINE, NAPTHA ETC.)
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D

Natural Gas Liquids Statistics

(Source: U. S. Bureau of Mines Report on Natural Gasoline and Cycle Plant Operations)

	Production (1000 gal./day avg.) Natural Gasoline	LPG**	TOTAL	Demand* (1000 gal./day avg.) Natural Gasoline	LPG	TOTAL
August '50	12,996	7,925	20,921	12,681	8,108	20,789
August '49	11,557	6,115	17,671	12,088	6,280	18,368
Change	+1,441	+1,810	+3,250	+593	+1,828	+2,421
% Change	12.7	29.6	18.4	4.9	29.1	13.2
	Total Production (1000 gal.)			Total Demand (1000 gal.)		
8 Mo. '50	2,388,328	1,880,683	4,378,011	2,939,027	1,858,877	4,797,904
8 Mo. '49	2,760,083	1,502,848	4,293,931	2,712,005	1,504,600	4,216,605
Change	+288,245	+385,835	+674,080	+227,022	+354,277	+581,299
% Change	10.7	25.6	16.0	8.4	23.5	13.8

	Stocks, End of Month (1000 gal.) By Type of Product: Natural Gasoline	LPG	Other Products†	By Location: Refineries	Gasoline Plants	TOTAL
August '50	236,563	76,735	51,087	115,248	248,767	364,015
July '50	228,256	85,722	52,676	120,120	246,534	366,654
August '49	207,340	53,640	49,438	104,076	206,342	310,418

* Demand, including exports but not transfers, is supplied from receipts from outside sources as well as current production and stock changes at gasoline plants. Outside receipts in August totaled 6,898,000 gals.

** Does not include LPG produced at refineries which in August totaled 94,584,000 gals.

† Includes naphtha, kerosine, specialty and other products.

ADVERTISERS' INDEX

FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

●

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

Fill in your name, title, company and mailing address and mail the card. . .no postage is required.

The Petroleum Processing Reader Service Department will give your inquiries prompt and efficient handling.

(A) ADVERTISING COUNCIL 1165

(B) ALLIED CHEMICAL & DYE CORP., BAKER & ADAMSON, GENERAL CHEMICAL DIV. ..... Inside Back Cover

(C) ALUMINUM CO. OF AMERICA.. 1209

(D) ALUMINUM CO. OF AMERICA.. 1224

(E) AMERICAN CYANAMID CO. 1156, 1157

(F) AMERICAN DISTRICT STEAM CO. 1249

(G) AMPCO METAL, INC. 1166, 1167

(H) BABCOCK & WILCOX CO., THE 1216

(I) BABCOCK & WILCOX TUBE CO., THE 1144

(J) BADGER & SONS CO., E. B. ..1142, 1143

(K) BADGER MFG. CO. 1208

(B) BAKER & ADAMSON, GENERAL CHEMICAL DIV., ALLIED CHEMICAL & DYE CORP. .. .. Inside Back Cover

(L) BONNEY FORGE & TOOL WORKS 1244

(M) BROWN FINTUBE CO., THE .. 1139

(BG) CARBIDE & CARBON CHEMICALS DIV., UNION CARBIDE & CARBON CORP. 1243

(N) CAREY MFG. CO., THE PHILIP 1164

(O) CHEMICAL CONSTRUCTION CORP. 1138

(P) CHICAGO BRIDGE & IRON CO. .. 1134

(Q) CHIKSAN CO. 1151

(R) CLARK MFG. CO. 1247

(S) COOPER-BESSEMER CORP., THE 1150

(T) CRANE CO., THE 1172

(U) DU PONT DE NEMOURS & CO., INC., E. I. 1148

(V) ETHYL CORP. 1133

(W) FILTROL CORP. 1161

(X) FLINT STEEL CORP. 1160

(Y) FLUOR CORP., LTD. 1251

(Z) FOSTER WHEELER CORP. ..... Facing 1164, 1165

(AA) FOXBORO CO., THE 1238

(AB) GENERAL AMERICAN TRANSPORTATION CORP. 1136, 1137

(AC) GRAVER TANK & MFG. CO., INC. 1163

(AD) GRAVER WATER CONDITIONING CO. 1155

(AE) GREENE, TWEED & CO. 1246

(AF) GRINNELL CO., INC. 1214

(AG) HARDESTY CO., W. C. 1226

(AH) HOKE, INC. 1246

(AI) HOPKINS VOLCANIC SPECIALTIES 1206

(AJ) HUDSON ENGINEERING CORP. ..... Inside Front Cover

(AL) LUMMUS CO. 1170, 1171

(AM) MATHIESON CHEMICAL CORP. 1232

(AN) METAL TEXTILE CORP. 1223

(AO) MONSANTO CHEMICAL CO.... 1147

(AP) MCKEE & CO., ARTHUR G. .. 1222

(AQ) NATASCO CO. 1213

(AR) NATIONAL AIROIL BURNER CO. 1242

(AS) NORDSTROM VALVE DIV. 1228, 1229

(AT) OAKITE PRODUCTS, INC. 1215

(AU) PACIFIC PUMPS, INC. 1240

(AV) PETRO-CHEM DEVELOPMENT CO., INC. 1149

(AW) PETROLEUM PROCESSING .. 1154

(AX) POWELL CO., THE WM. 1162

(AY) PRECISION SCIENTIFIC CO.... 1158

(AZ) PRITCHARD & CO., J. F. 1225

(BA) PRITCHARD & CO., J. F. 1250

(BB) ROOTS-CONNERSVILLE BLOWER CORP. 1231

(BC) SELAS CORP. OF AMERICA.. 1168

(BD) SHELL OIL CO., INC. 1219

(BE) SHERWIN-WILLIAMS CO., THE 1210

(BF) TAYLOR FORGE & PIPE WORKS 1212

(BG) UNION CARBIDE & CARBON CORP., CARBIDE & CARBON CHEMICAL DIV. 1243

(BH) UNITED STATES GASKET CO. 1207

(BI) UNIVERSAL OIL PRODUCTS CO. 1152, 1153

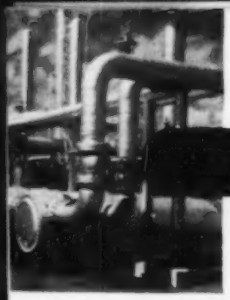
(BJ) UNIVERSAL OIL PRODUCTS CO. 1245

(BK) WEDGEPLUG VALVE CO., INC. 1245

(BL) WORTHINGTON PUMP & MACHINERY CORP. 1169

(BM) WYATT METAL & BOILER WORKS ..... Outside Back Cover

(BN) YARNALL-WARING CO. 1218

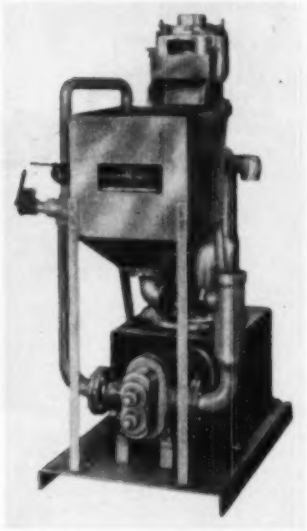


WHAT'S NEW!

Equipment
Materials
Processes
Literature

Reviewed by WILLIAM C. UHL, Equipment Editor

New Grease Processing Mills Include Model with Capacity to 8000 lbs/hr



Three new models of the Morehouse "Speedline" mills for processing greases and lubricants, and a new deaerator unit for eliminating entrained air have been developed. They are designated as: Model MG for laboratory testing and control and custom runs; Model B-1405 for production runs with capacities as high as 8000 lbs./hr.; and Model B-1405 with or without the deaerator unit. The machines can provide fine grinding, dispersing, mixing, and disintegrating of a wide variety of materials ranging from water-thin to heavy paste viscosities. Mills are available in cast iron and stainless steel and in a wide range of electrical requirements. All parts are easily cleaned and are quickly interchangeable. The mill shown in the illustration is the Model B-1405 with a deaerator unit. Morehouse Industries.

Circle No. **1** *on Reply Card*

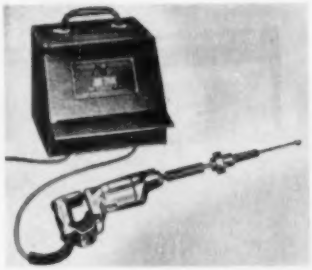
Combustible Gas Indicator Is Designed Specifically for Use on TEL Gasoline

The Davis "Vapotester Model M-1, Type L" is a combustible gas indicator designed specifically for use on leaded gasoline. Manufacturer states it cannot be "poisoned" by tetraethyl lead and that it is the only indicator thus far approved for use on leaded stock by the Underwriters' Laboratories and Factory Mutual Laboratories. The instrument operates on the Wheatstone Bridge principle. Two legs are identical interchangeable filaments: one, the analyzing filament is exposed to the sample; the other, a reference filament, is sealed in air. The other two legs are fixed resistors whose resistance is increased by the sample burning on the analyzing filament. This causes a flow of current through the meter. The unit also is suitable for determining the gas-free condition of tanks or vessels following steaming and purging. Davis Emergency Equipment Co., Inc.

Circle No. **2** *on Reply Card*

New Tube Rolling Control Employs No Electron Tubes or Voltage Regulator

Low initial cost and little or no maintenance are cited as advantages of the new "John Crane" tube rolling control for both ferrous and non-ferrous tubing. Using no electronic tubes or voltage regulator, the unit has only two electrical working parts, shock-proof mounted and enclosed in an aluminum cabinet. These parts may be removed as a unit and replaced when necessary. Dial settings on the control panel are calibrated over a wide range of sizes and



gauges. In operation, the expanding gun is plugged into the Control unit, and the proper dial setting made. Slight pressure on the gun handle engages the Control in the circuit. As soon as the tube is rolled the proper degree, the Control cuts off the motor. The manufacturer states over-expanding and under-expanding of tube ends is eliminated with this tool. In addition, radial and hoop stresses in the tube sheet are eliminated because the holes are not enlarged or distorted. Crane Packing Co.

Circle No. **3** *on Reply Card*

Slide Rule Flash Calculator Described In Petroleum Processing Now Available

The Blaw-Knox slide-rule type, equilibrium flash calculator rapidly solves flash calculations which involve the determination of the quantity of each component in a given hydrocarbon mixture existing in the liquid and vapor phases under different conditions of temperature and pressure. The development, uses, and advantages of the tool were described in PETROLEUM PROCESSING, September, 1950, pages 948-949. It is intended primarily as a time-saver, and can be used either for final solutions with an accuracy of plus or minus 1%, or for preliminary approximations when greater accuracy is needed. Decimal points are located automatically over the wide range of values normally encountered. It may be purchased, complete with operating instructions, at $2.50 postpaid. Chemical Plants Div., Blaw-Knox Construction Co.

Circle No. **4** *on Reply Card*

For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage required.

On Stream *Automatically* without Manual "Juggling" of Control!

Twin naphtha rerun stills at El Segundo Refinery of Standard Oil Company of California, built by C. F. Braun, Co.

. . . thanks to Foxboro M-40 Controllers

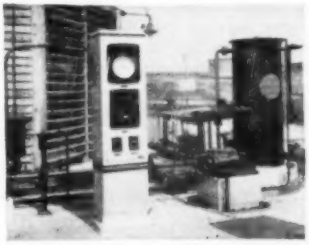
At the El Segundo Refinery of the Standard Oil Company of California, fast, sure start-ups typify the operation afforded by M-40 Controllers on two new naphtha rerun stills.

Because each pre-set value is so accurately met by the M-40 Controllers, every process temperature, pressure and flow rate comes directly to its control point without any manual "babying". And the inherent stability of M-40 control action *holds* it there for maximum process-uniformity.

The Foxboro M-40 Controller gives you the benefit of the most advanced developments in the field of pneumatic instrument design. Its rigid unit construction and almost frictionless moving parts result in greater power, accuracy, and sensitivity. Available for temperature, pressure, flow, level and other applications.

Write for details. **The Foxboro Company, 16 Neponset Ave., Foxboro, Mass., U. S. A.**

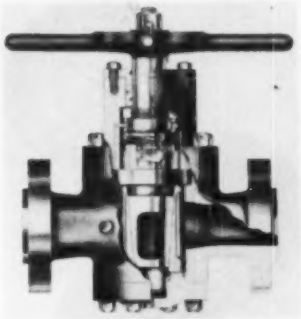
One corner of the control room, showing a few of the M-40 Controllers which automatically operate the process.



pH controller for cooling tower. It holds pH of process cooling water within desired limits.

FOXBORO CONTROLLERS

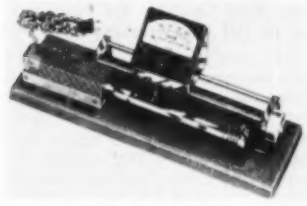
Reg. U.S. Pat. Off.



Non-Lubricated Valves Handle Most Fluids under Wide Service Conditions

The Kerotest General Twin Seal Valve has been announced as a new non-lubricated plug valve for operation in normal to sub-zero temperatures on all types of gaseous and volatile liquid service. Daily maintenance is eliminated by the non-lubricating feature. Valve seats retract before rotation of plug, assuring free rotation and elimination of wear, scoring, galling, or sticking. Individual seats expand against body ports in closed position. Seat inserts are replaced through bottom plate of valve without disassembly. One and a quarter turns operates from full open to full closed. Valves are supplied in flanged or screwed end in sizes from 2 to 8 in., for cold working pressures from 230 to 2000 psi. Sizes 2 to 4 in. are also available for cold working pressures of 3000 and 5000 psi. Dimensions conform to API and ASA standards. Bodies and covers are cast steel conforming to API standards. Seats may be of 18-8 stainless steel, Monel, bronze, or Hycar-bonded stainless, or any combination of above. Special materials can be supplied for specific service requirements. Kerotest Mfg. Co.

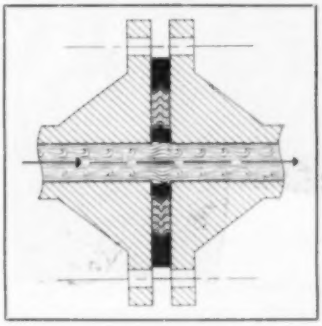
Circle No. **5** *on Reply Card*



Meter Obtains Melting Points of Many Common Materials at 20 to 500° F.

Fast and accurate determination of melting points between 20 and 500° F. of waxes, resins, gums, tars, fats, plastics, low melting alloys, organic compounds, and inorganic compounds can be made with the new "Model 304" Clarkstan Melting Point Meter. Samples may be as small as a few milligrams, and can be recovered uncontaminated with reasonable precaution, the manufacturer states. The instrument operates by placing a small sample on a chromium plated platen or bar, which is electrically heated so that a temperature gradient obtains along its length. By observation, the demarcation between molten and solid particles is determined. At that point the small thermocouple junction is placed. A temperature indicator quickly gives the temperature at the point chosen. A screw feed allows the operator to follow the melting point as the bar temperature changes. Both platen and thermocouple are easily removed for cleaning and for change in case of damage or contamination. The unit operates on 100 volts AC or DC. Net price quoted is $135.00. Clarkstan Corp.

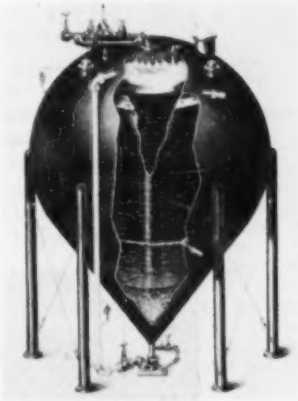
Circle No. **6** *on Reply Card*



High Pressure Flange Gasket Cuts Turbulence, Improves Flow at Joint

A new high pressure flange gasket, Style CGI, streamlines jointed connections, reducing turbulence. It is a compression gage type with both an inside and an outside ring. It is a spiral wound construction with alternating V-crimped plies of metal and filler. Its effect is to fill the flange recess, as shown in the picture, so that no turbulent barrier of fluid is set up. The gasket is made for practically all standard ASA and API fittings as well as special designs. Pressure range is 150 to 2500 psi. In addition to stainless steels, the inside ring can be had in other premium metals such as Monel, nickel, or Inconel. The gasket is designed so the inside ring can be remounted in new replacement gaskets. It is also being used with the self-centering type (Style D), made for raised face, smooth face Vanstone, and lapped joints, as well as the Style R-1 for large male and female joints. Flexitallic Gasket Co.

Circle No. **7** *on Reply Card*



Special Shape of Sedimentation Tank Improves Efficiency, Cost of Softener

A material reduction in steel requirements is a feature of a new design in sedimentation tanks for hot process water softeners, consisting of a hemisphere mounted on top of an inverted cone. In addition, this Graver "Sphericone" improves the functional requirements of such a tank. Customary standard cylindrical shape with dished top and conical bottom has been a compromise between functional and structural ideals. Functional requirements for that design are large capacity in a shape that provides low rising rates and largest possible settling area for the treated water. In the new design, the inverted cone provides the uniformly increasing area from tip to circular top, while the hemisphere provides the natural strength superiority inherent in its shape as compared to a cylinder. The raw water, steam and chemical inlets, spray heater, deaerator, and treated water collector are all mounted in the hemisphere. The cone contains the downtake, sludge bed, and water rising zone. Several Sphericones have already been built, including a 600,000 lb./hr. tank. Graver Water Conditioning Co.

Circle No. **8** *on Reply Card*

TO *Reduce* YOUR SLURRY PUMPING *Costs*

SPECIFY

Pacific

Precision Built

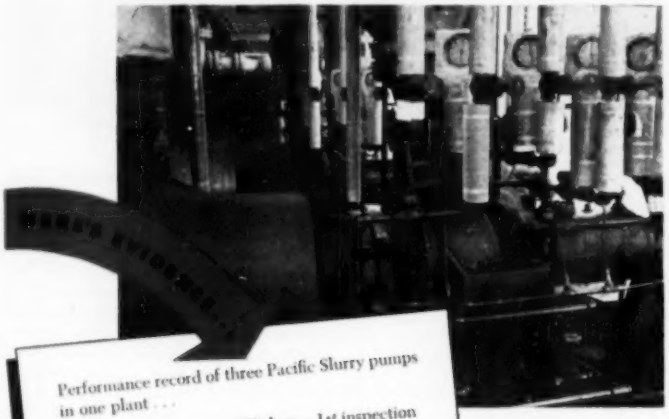
SLURRY PUMPS

1 Pacific's special design provides maximum protection for wearing rings, shaft sleeves and packing.

2 Precision workmanship insures the perfect fit necessary to prevent destructive cutting of parts caused by leakage from high to low pressure areas.

3 All parts are fabricated from materials selected for strength, toughness and resistance to erosion and corrosion.

A combination that decreases frequency of down time, decreases frequency of parts renewal and decreases maintenance cost.



Performance record of three Pacific Slurry pumps in one plant . . .

1st run—on stream . . 270 days—1st inspection
2nd run—on stream . . 420 days—no inspection
3rd run—on stream . . 420 days

Total On Stream . . 1110 days—2nd inspection

1st inspection made on 1 pump only. No parts were replaced as the condition of the pump was perfect.

On the 2nd inspection each pump was examined. Wearing rings and shaft sleeves were replaced in all 3 pumps and the impeller in one.

Exceptional Performance? No . . . just average!

Write for Bulletin 86A

PR-10

Pacific Pumps inc.

HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York
Offices in All Principal Cities

PACIFIC *Precision Built* PUMPS

What's New!

Pressure Gage Blow-out Disc Covers Entire Back of Case for Easy Repairs

Construction of the new "Acragage" pressure indicator features an increase in safety to operating personnel and easier maintenance, the manufacturer states. It is a solid front type of gage case incorporating a solid cast web backing up the dial, with the back of gage case covered by a waterproof blow-out disc with bonded Buna N seal. In event of Bourdon tube rupture, the blow-out disc relieves the pressure in the case, acting positively at pressures between 0.5 and 3 psi., depending on case size and connections. Removal of the disc exposes the entire mechanism for inspection, repair, or recalibration without removing the dial. The gage is available in sizes from 4½ through 10 in. in surface and flush mounting designs. It comes with all types of Bourdon tubes for ranges from 30-in. Hg. vacuum to 80,000 psi. Standard movements are either of stainless steel, or nylon and stainless steel, the latter being designed for high frequency pulsation service. Clapp Instrument Co.

Circle No. **9** *on Reply Card*

Extra Hard Catalysts Are Developed For Air-Lift Type Cracking Units

Two new cracking catalysts have been announced which are said to be suited for use in the new Houdriflow and Socony-Vacuum air-lift type cracking units. They are a very hard type, regular Filtrol TCC catalyst and a very hard SR (sulfur resistant) pelleted catalyst. Large quantities will be manufactured with the completion in late Spring of 1951 of the $1,000,000 construction program of the Filtrol Corp.

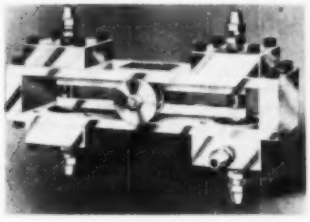
Circle No. **10** *on Reply Card*

[*To obtain more data on advertised products see page* 1236]

Laboratory Mixer Holds Containers Of any Shape or Size up to 5 Gal.

The "Lanco Tumbler-Mixer" will hold any size container—from 5-gal. cans to 1-ounce bottles, square, round, or irregular — and can be tilted through a 90° arc for mixing at any angle. Turntable is 19 in. in outside diameter. Motor is 1/6 hp., 110-volt, AC single phase, with start-stop switch and eight ft. of cord. Floor space required is 32 x 19 in. Height of the unit, when fully raised, is 35 in. Total weight is 80 lbs. Price is $96.50, including motor, switch, and cord. Arthur S. La Pine & Co.

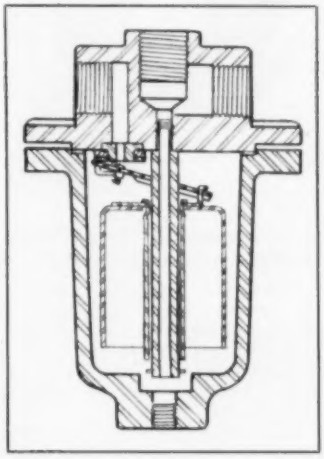
Circle No. **11** *on Reply Card*



Radio Totalizer Produces One Output From up to Three Input Signal Loads

The Hagan "Ratio Totalizer" is a pneumatically-operated control mechanism designed to receive several control signals or pressures and produce a single output loading pressure in any desired ratio to the incoming loads. It can accommodate as many as three input signals plus three spring forces in a single unit, and is said to be applicable to general process control, power plant regulation, etc. The Totalizer is designed for use in computing circuits for such functions as addition, subtraction, multiplication, and division of control signals; and in control circuits for introducing proportional band action, rate action, or automatic reset, either separately or in any desired combination. The standard assembly consists of a bar stock steel frame with nonmetallic flexible diaphragm elements in each of four chambers. An adjustable fulcrum allows broad adjustment of output loading pressure, which may be in the ranges of 3-16, 0-30, or 0-60 psi. Any input pressure chamber may be fitted with an adjustable tension spring with a maximum tension equivalent of up to 60 psi. loading pressure. Bellows-type pressure elements, which are interchangeable for use with pressures above 60 psi., may be fitted to any of the input chambers. Hagan Corp.

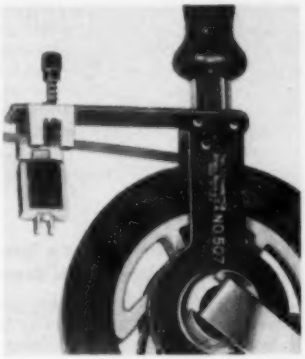
Circle No. **12** *on Reply Card*



Small Forged Steel Traps Withstand High Pressure, Superheated Steam

Two new models of small forged steel steam traps with ½ or ¾ in. pipe connections are suitable for high pressure, super-heated steam service, up to 500 psi. with 800° F. total temperature. Internal parts are of stainless steel with valve and seat of "Anderloy," a special alloy developed by the manufacturer for steam service. Gasket is recessed to prevent blowing out. Traps are made in two principal types. No. 340 (shown in illustration) is installed straight-in-line or as an elbow eliminating nipples and fittings, saving about one hour's installation time. No. 60 (not shown) is designed with the inlet in the bottom and outlet in the top for vertical installations. V. D. Anderson Co.

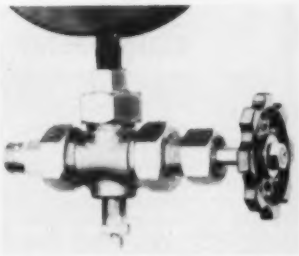
Circle No. **13** *on Reply Card*



Quickly Attachable Wiper Accessory Keeps Gage Tape Ribbon Clean

A gage tape wiper has been developed that can be readily attached to any Starrett frame-type tape and is designed to remove oil and dirt as the tape line is reeled in. It can be quickly mounted on the stud which secures the hand grip to the frame. Both sides of the tape are wiped clean by pads held in uniform contact under spring pressure. A bayonet lock permits the upper pad plate to be released and swung aside to facilitate pad replacement or removal of the wiper. L. S. Starrett Co.

Circle No. **14** *on Reply Card*



Valves for Instrument Piping Permit Reduction in Threaded Connections

Reduction of threaded connections from ten to three is said to be a feature of a new line of valves for instrument piping or for general use. The valves, which combine unions, nipples, reducers, elbows, tees, valve, and drain valve into one space-saving unit, are offered in nine styles including valves with or without union outlet as well as offset and jacketed valves. Features available on all or many of the nine styles include: safety shut-off; double-seating stem

for repacking under pressure; choice of regular or quick-closing steam and lever; regrindable and renewable seats; pressure bleeder valve and test gage connection; outside screw and yoke when desired; and throttling stem when desired. Jerguson Gage & Valve Co.

Circle No. **15** *on Reply Card*

Hydrogenated Castor Oil and a Fatty Acid Offered as Materials for Grease

Two chemicals with promising uses as chemical intermediates and in lubricating greases are now in commercial production by Emery Industries. They are 12-Hydroxystearic Acid and Hydrogenated Castor Oil. A major established application for the acid, an 18-carbon saturated fatty acid with a hydroxyl grouping on the 12th carbon atom, is in manufacture of lithium base greases. The reactive hydroxyl radical is said to make the chemical a potential intermediate for synthesis of new products. It is a hard amorphous solid with a capillary melting point of approximately 73° C. The free fatty acid content as a 300 molecular weight acid is 95% minimum. Other characteristics are low iodine value and light color. Principal use of the castor oil also is in greases, but it shows promise in specialty uses such as impregnating and insulating agents for electrical products. It is a hydrogenated triglyceride consisting of approximately 85% of combined hydrogenated ricinoleic acid (12-hydroxystearic). It is a hard amorphous solid with a melting point of about 82° C. and an iodine value of 5.0 maximum. Color is light and acid value low. Emery Industries, Inc.

Circle No. **16** *on Reply Card*

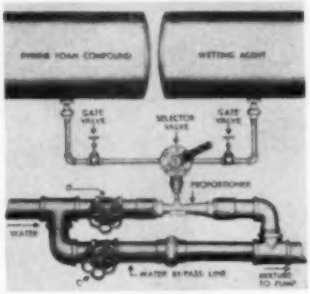
Teflon-Impregnated Asbestos Packing Available in Convenient Braided Form

Teflon, the highly corrosion and heat resistant plastic material introduced to industry in recent months, has now been adapted for use in a braided form of packing, "Palmetto 1330" Teflon-impregnated packing. The product is prepared from chemically pure blue asbestos yarn, each strand of which is impregnated with the Teflon, thus providing full resistance to acids, alkalies, corrosive chemicals and solvents, from —150 to 550° F. The yarn then is braided tightly to avoid leakage through the cross section. It can be cut or formed to any required packing size. It is supplied in sizes from ⅛ in. square up, and put on 1-lb. spools, 25, 50, and 100-lb. reels, or in 5½ and 13 lb. boxes. Greene, Tweed & Co.

Circle No. **17** *on Reply Card*

Selector Valve Improves Efficiency Of Foam Fire Fighting Equipment

Mobile fire apparatus, fire fighting trailers, or stationary installations can make their supply of water more efficient at the turn of a valve by employing either air foam compound or a wetting agent. A new selector



valve for use with a suction side proportioner makes it possible to introduce either a 1 or 2% proportion of wetting agent or a 5% concentration of foam compound into the water stream. The stainless steel valve has a four-position dial for 1% and 2% of wetting agent, 5% of foam compound and an "off" position when plain water is to be discharged. Foam discharge with 1% wetting agent is used for Class A fires, with 2% it is used for Class B fires. Water with wetting agent is most commonly used with fog nozzles. Pyrene Mfg. Co.

Circle No. **18** *on Reply Card*

New Instrument Provides Rate Action In an Electrically-Actuated Control

A new control system—"P.A.T. '50'"—is said for the first time to introduce rate action into an electrically-actuated control. Rate action's significance is that it responds according to the speed with which the controlled variable changes—and thus improves process output by reducing the length of time that an upset can force the controlled process off its set point. For example, if furnace temperature begins to fall, rate action immediately opens the fuel valve. The faster the drop in temperature, the wider the valve is opened. And as the rate of tempera-

industrial
OIL AND GAS BURNING EQUIPMENT

- Mechanical Atomizing Oil Burners
- Steam Atomizing Oil Burners
- Refractory Burner and Muffle Blocks
- Industrial Gas Burners
- Low Air Pressure Oil Burners
- Fuel Oil Pump Sets
- Valves, Strainers, Furnace Windows
- Tandem Block Combustion Units
- Combination Gas and Oil Burners

Detailed information gladly sent you upon request.

NATIONAL AIROIL BURNER

NATIONAL AIROIL BURNER COMPANY INC.

1297 Sedgley Ave., Philadelphia 34, Pa.
Southwestern Division: 2512 So. Blvd., Houston 6, Tex.

Project & Process Engineering
Water Conditioning Equipment
Petroleum Refinery Engineering
Chemical Plants

NORMAN O. ELDRED
Consulting Chemical Engineer

Registered Professional Engineer
State of Illinois
Associate Member A.I. Ch.E.

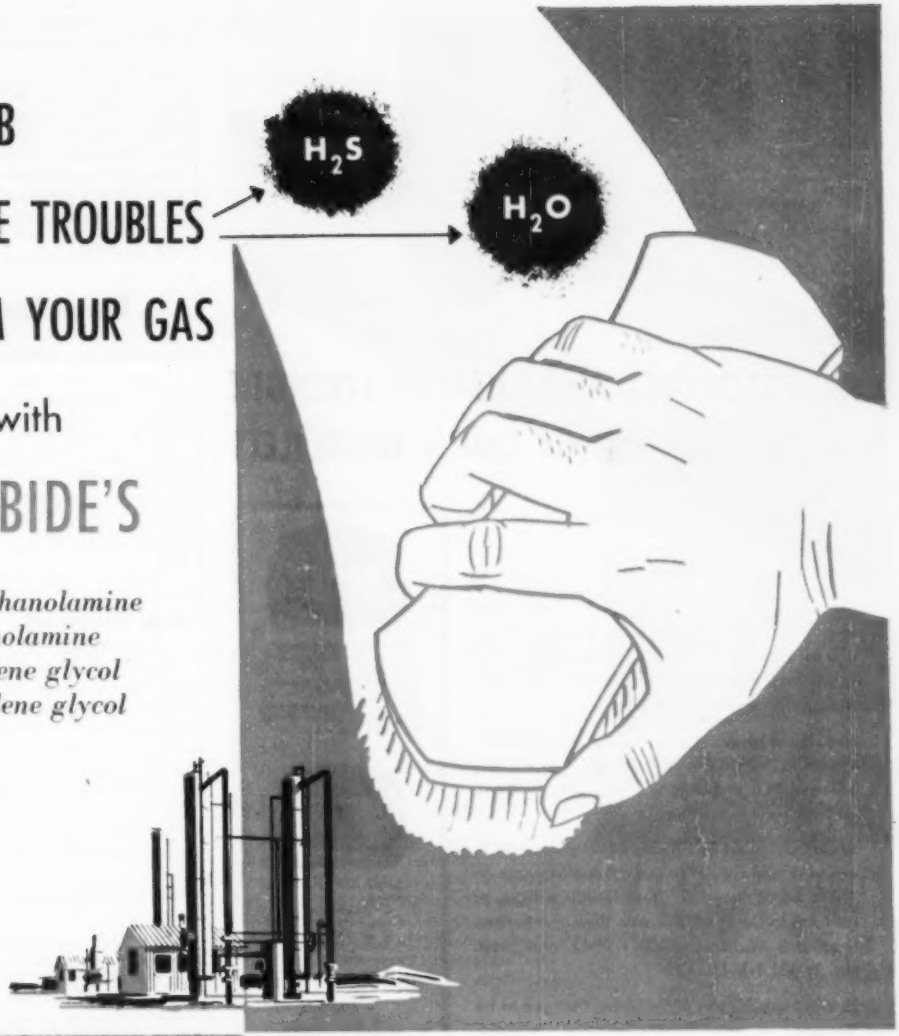
508 Draper St., Vicksburg, Mich.
Vicksburg 3271

SCRUB THESE TROUBLES FROM YOUR GAS

with

CARBIDE'S

monoethanolamine
diethanolamine
diethylene glycol
triethylene glycol



CARBIDE AND CARBON CHEMICALS DIVISION

Union Carbide and Carbon Corporation

30 East 42nd Street New York 17, N. Y.

Offices in Principal Cities

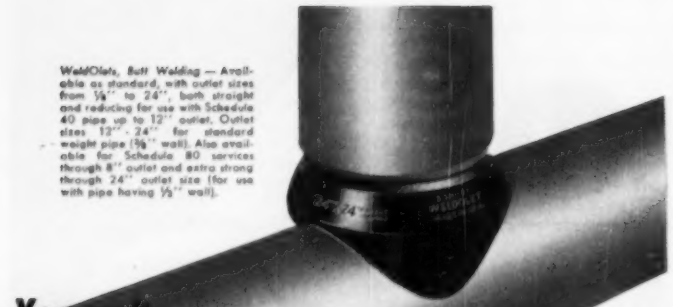
In Canada:
Carbide and Carbon Chemicals, Limited, Toronto

DESULFURIZE . . . and eliminate a serious trouble-maker. Monoethanolamine and diethanolamine efficiently scrub corrosive hydrogen sulfide out of natural gas and refinery gas. The hydrogen sulfide removed is a source of saleable sulfur.

DEHYDRATE with the glycols and prevent formation of pipe-clogging hydrates in high pressure transmission lines. This helps you maintain transmission line capacity and avoid valve and regulator clogging.

You can order CARBIDE's ethanolamines and glycols in tank cars and drum carloads. Delivery of less than carload lots, in drums, can be made from CARBIDE warehouses in Dallas, Houston, Tulsa, Denver, Los Angeles, San Francisco, and 46 other cities throughout the country.

For gas-scrubbing chemicals that do the job, get in touch with the nearest CARBIDE office.



WeldOlets, Butt Welding — Available as standard, with outlet sizes from ⅛" to 24", both straight and reducing for use with Schedule 40 pipe up to 12" outlet. Outlet sizes 12" - 24" for standard weight pipe (⅜" wall). Also available for Schedule 80 services through 8" outlet and extra strong through 24" outlet size (for use with pipe having ½" wall).

You write

SPEED, ECONOMY AND FULL PIPE STRENGTH

***into the job when you specify* WELDOLETS**

With WeldOlet branch pipe welding fittings you provide the quickest, most economical, most satisfactory method of obtaining full pipe strength at branch connections.

Note in the above illustration how the WeldOlet tapers to provide a single bevel groove joint at the crotch section and blends into a V-butt joint at the ear portion.

WeldOlets need no additional reinforcement to establish and fully maintain original strength on ASTM A-106 Seamless Steel Grade A Pipe, as set forth in Code for Pressure Piping, American Standards Association, B31.1-1942, and Supp. No. 2, B31.1-b-1947.

To meet special conditions, these fittings can be furnished in any forgeable metal including wrought iron, toncan iron, nickel, Monel, Everdur, stainless grades 304, 316, 347, etc.

For detailed engineering reference data, write for Catalog W-2.

WeldOlets, Socket Welding — Available as standard, with outlet sizes ⅛" - 10", both straight and reducing, for use with Schedule 40 pipe. Also available in Schedules 80 and 160 up through 4" outlet size.

ThredOlets — Available as standard, with outlet sizes ⅛" - 10", both straight and reducing, for use with Schedule 40 pipe. Also available in Schedule 80 up through 2" outlet size.

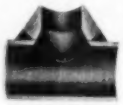


Fig. 1 — Cut-away view of reducing size WeldOlet with welding outlet in place. The external rib and wide bases or footings of WeldOlets eliminate the need for extra supports to take care of bending or vibrational stresses at crotch section, the point of greatest stress.

Fig. 2 — Note blending of ear portion of welding fitting to run pipe. Extension of weld metal below inside scarfed portion of pipe insures all sections of joint greater than pipe wall thickness.

BONNEY FORGE & TOOL WORKS

Forged Fittings Division, 368 Green Street, Allentown, Pa.

Authorized Canadian Factory Representative:

Sterling Steel Co., Ltd. 267 Davenport Road
Toronto, Canada

WELDOLETS

FOR WELDED BRANCH PIPE OUTLETS

What's New!

ture departure decreases, rate action's effect also decreases. The system also has proportional and reset control action, and is applicable to the regulation of temperature, pH, chemical concentration, and gas analysis. Leeds & Northrup Co.

Circle No. **19** *on Reply Card*

Trade Literature

Anti-Oxidation Additive

Anti-Oxidant 2246, Cyanamid New Product Bulletin No. 16: 13 pages of technical data on a series of modified sodium polyacrylates, outlining their properties and discussing their compatibility with surface active agents; the compounds being applicable in paraffin waxes, gasolines and other petroleum products. American Cyanamid Co.

Circle No. **20** *on Reply Card*

Water Conditioning

Water Patrol for Profit Control; a 12-page brochure describing in nontechnical language the causes of corrosion, scale, algae, and the like in heat exchange equipment, lines, boilers, cooling towers, etc., and its treatment by chemical compounds, many of which are specifically formulated for each problem by service engineers with Aquatrol, Inc.

Circle No. **21** *on Reply Card*

Alloy Selection Guide

Materials Selection Chart; a four-page folder covering 350 different corrosive conditions and tabulating carbon steel along with more expensive alloys in order of increasing cost, indicating service expected. Cooper Alloy Foundry Co.

Circle No. **22** *on Reply Card*

Automatic Water Still Cut-Off

"Lectrol" Automatic Low Water Cutoff, Bulletin 911: describes operating principle of an electronic low water level control for laboratory stills; including catalog information and prices. Precision Scientific Co.

Circle No. **23** *on Reply Card*

Tank Agitators and Mixers

Eastern Fixed Mounting Mixers . . . Top and Side Entering, Bulletin No. 600: 16 pages of catalog information on propeller type agitators including dimensions, specifications, engineering suggestions, installation data. Eastern Industries, Inc.

Circle No. **24** *on Reply Card*

Hardfacing Alloys

Airco Hardfacing Alloys Combat Wear, Catalog 11; 20 pages covering nine ferrous alloys, two non-ferrous cobalt alloys, and four tungsten carbide type, for various applications ranging from abrasion to corrosion, erosion, and impact problems, giving typical applications for each type, general specifications, and including a hardness conversion table, grinding wheel specifications, and preheating chart. Air Reduction Sales Co.

Circle No. **25** *on Reply Card*

Process Centrifugal Pumps

Pacific Single Stage Centrifugal Pumps for Process Service, Bulletin 108; eight pages covering Types SVC and SEC single suction pumps with the following ratings, sub-zero to 300 and 800° F.; 15 to 1500 gpm.; 500 and 600 psig. working pressure; 600 ft. max. head; 4000 and 3600 rpm.; 1 to 6 in. pipe size; including a pump-size selection chart and dimension table. Pacific Pumps Inc.

Circle No. **26** *on Reply Card*

Lube Plant Made from Surplus Units

Kellogram No. 4, 1950; tells how a complete but surplus alkylation-isomerization unit was converted into a 1500 b/d solvent refining, lubricating oil plant at a saving in materials estimated in the millions for Phillips Oil Co. at Kansas City, Kans. M. W. Kellogg Co.

Circle No. **27** *on Reply Card*

Solvent Extraction Column

Semi-Commercial Multi-stage Extraction Column; a 16-page reprint covering the performance characteristics of a 12-in., three-stage solvent extractor, presenting data on the effect of agitator speed, liquid throughput on stage efficiency and on other phases entering into the design and operation of pilot or plant scale equipment. Otto H. York Co., Inc.

Circle No. **28** *on Reply Card*

Valve Testing Techniques

Valve Values, Vol. 10, No. 35; includes an article describing new testing techniques used in designing Edward valves for lower pressure drop and minimized turbulence, and also a pressure-temperature rating table conforming to ASA B16e6-1949, punched for filing, or for use under glass topped desks. Edward Valves, Inc.

Circle No. **29** *on Reply Card*

Sweetland Pressure Filters

Sweetland Pressure Filter, Bulletin No. 11; describes construction, typical operating cycle, and gives general catalog data on line of filters in sizes from laboratory unit with 1½-5 sq. ft. to full scale units with 480-1000 sq. ft. of area. Oliver United Filters Inc.

Circle No. **30** *on Reply Card*

Aluminum Oxide Porous Media

Porous Media for Filtration and Diffusion by Carborundum, a 56-page booklet providing complete reference data on applications for ceramically bonded aluminum oxide—Aloxite—including charts, tables, and illustrations dealing with uses, design, installation, operation, specifications, etc. The Carborundum Co.

Circle No. **31** *on Reply Card*

Steam Jet Syphons

Steam Jet Syphons, Bulletin 2A; 24-page catalog detailing the design, application, construction, and operations of various syphon types available; with dimensions, prices, capacities, etc. in tabular form; and including data on typical uses, with colored drawings. Schutte and Koerting Co.

Circle No. **32** *on Reply Card*

Corrosion Protective Coatings

Rust-Oleum, a new 16-page catalog, including 70 color chips of the various items in a line of rust-preventive, heat and chemical-resistant coatings for metals, wood, and masonry, including specifications, drying time, thinner requirements, and methods of application. Rust-Oleum Corp.

Circle No. **33** *on Reply Card*

Refractory Arch Construction

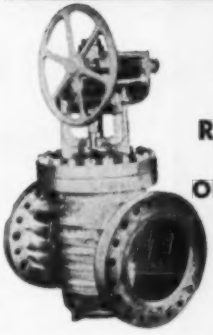
Reintjes Double-Hung Refractory Arch, Bulletin 950, describes how the arch hangs and moves like a pendulum, the ease of installation, and positive locking arrangement between lower and upper tiles, preventing disengagement in service in furnace construction. Geo. P. Reintjes Co.

Circle No. **34** *on Reply Card*

Temperature Instrumentation

The Design and Process Engineer's Guide to Industrial Temperature Measurement and Control, Bulletin No. 101; a 24-page booklet covering temperature measurement by mercury-bulb devices and tracing the development of that method from the

WEDGEPLUG
ALL-PURPOSE
STEEL VALVES



LIFTS
TURNS
and
RE-SEATS
IN ONE
OPERATION

• DRY PLUG •

PRICED to compete with conventional plug-type valves. Interchangeable with American Standard Steel Wedge Gate Valves. Wrench-Operated; Direct Handwheel-Operated; Worm Gear-Operated; Sizes from 1" to 16". Write for our Catalog No. 600 and Price List. On request, we will be glad to quote on larger sizes above 16".

Wedgeplug Valve Co., Inc.
Department "P"
New Orleans 15, U.S.A.

it's made of stainless steel
to the most rigid specifications

PRESSURE SAMPLE CONTAINERS

ICC Approved

Invaluable for sampling liquids and gases

At last here are the Hoke Pressure Sample Containers standard pressure vessels made of stainless steel to the most rigid specifications.

This new Hoke product is proving invaluable for sampling of both liquids and gases. They are ICC approved and available in two standard service pressure ranges, namely: 400 psi and 1800 psi. Either double or single valving is obtainable. 18-8 Stainless Steel is standard material. Other metals, ferrous or non-ferrous, manufactured on special order.

Write for Folder PP-11 giving details and prices

OK

Hoke Incorporated

ENGLEWOOD, N. J.

PALMETTO MOLDS A KUP THAT NEVER DRIES OUT

. . . will not "dry out" under stress of heat or from non-use during shutdown periods. Special Palmetto compositions keep Kup resilient at all times . . . makes Kup the perfect answer for longer life, less downtime, of air cylinder operated equipment.

ANOTHER THING: Kup is stronger at the heel—because the synthetic compound, reinforced with fabric, is molded to shape under heat and pressure—not stretched to shape!

Palmetto Kup is available, with or without fabric, in various compositions and hardnesses to suit every hydraulic and pneumatic application.

Write for Bulletin MP-20

GREENE, TWEED & CO.

NORTH WALES, PENNSYLVANIA

MORAN'S® COUPLINGS

"TUSKO" WALRUS POLISHING LEATHER

Contact your fully-stocked Palmetto distributor on all packing problems . . . ask him about our special tools.

What's New!

eight known methods of responding to temperature changes. The Partlow Corp.

Circle No. **35** *on Reply Card*

Thermocouple Manual

Wheelco Data Book and Catalog, 1950 Edition, Bulletin TC-8; 42 pages of prices, application information, and technical data on thermocouples, radiation detectors, resistance bulbs, and other accessories for indicating, controlling, and recording instruments. Wheelco Instruments Co.

Circle No. **36** *on Reply Card*

Heat Transfer Equipment

Alco Catalog AL-3; 16 pages of information on heat exchangers, evaporators, feedwater heaters, pressure vessels, and pipe, with dimensions, cut-a-way and cross-sectional drawings, and design and selection data. American Locomotive Co.

Circle No. **37** *on Reply Card*

Motor Oil Manufacture

Heat Engineering, Vol. 25, No. 8, August, 1950, contains an article describing the blending, packaging, and shipping of motor oils in the Whiting, Indiana, plant of Standard Oil Co. (Indiana) in facilities engineered by Foster Wheeler Corp.

Circle No. **38** *on Reply Card*

Corrosion-Proof Cements

Atlas Corrosion Proof Cements, Bulletin No. 5-1; eight-page brochure covering line of resin, asphaltic, silicate, and sulfur cements, with complete technical information and table of resistance to common and other corrosive materials. Atlas Mineral Products Co.

Circle No. **39** *on Reply Card*

Anti-Corrosion Coatings for Metal

3M Adhesives, Sealers, and Coatings; a 32-page catalog covering sprayable and air-drying coatings to protect metals against acids, chemical fumes, solvents, crude petroleum impurities, high humidity and salt water. Minnesota Mining and Manufacturing Co.

Circle No. **40** *on Reply Card*

Photoelectric Colorimeter

Lumetron Photoelectric Colorimeter Model 401, Bulletin No. 409; four pages of technical description and price information on a new instrument designed for colorimetric determinations of many materials, including mineral oils, solvents, synthetic materials. Photovolt Corp.

Circle No. **41** *on Reply Card*

What's New

Lube Plant Instrumentation

Instrumentation, Vol. 4, No. 6, Third Quarter, 1950; includes a five page article describing instrumentation at the huge lube oil refinery of Cit-Con Oil Corp. in Lake Charles, La., and also an article on the use of pneumatic controllers to regulate engine-driven gas compressors in a butyl rubber plant. Brown Instrument Co.

Circle No. **42** *on Reply Card*

Electrical Equipment for Refineries

Electrical Specialties for Hazardous Locations, Catalog No. H-47; 100 pages of complete technical and engineering data on all types of electrical equipment, lighting fixtures, boxes, switchgear, panels, starters, etc.; including suggested layouts for bulk stations, and typical hazardous area installations. Russell & Stoll Co.

Circle No. **43** *on Reply Card*

Centrifugal Process Pump

Three Things You've Always Wanted in a Centrifugal Pump; Bulletin No. 1001; gives general description, cross section drawing, rating tables, and dimension print of the De Laval Type GS Pump, in sizes from 2½ to 4 in., for capacities to 400 gpm. and heads to 200 ft., offered on a Service and Exchange Plan for easy, inexpensive maintenance. De Laval Steam Turbine Co.

Circle No. **44** *on Reply Card*

Temperature Instruments

Microsen Temperature Indicators and Recorders, Bulletin 404; 12 pages of technical data on a line of thermocouple-actuated electrical temperature measuring instruments for the range —100 to 3000° F., describing construction and principle of operation, including specifications and prices. Manning, Maxwell & Moore.

Circle No. **45** *on Reply Card*

For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the bottom of the card and drop it in the mail. No postage required.

Anyway you figure it....

You get TWICE the VALUE with...

Clark DUO-STEP Leverage STEAM TRAPS

HERE'S HOW DUO-STEP WORKS:

1. Shows orifice closed.

2. First fulcrum point "cracks" orifice.

3. Second fulcrum point moves valve from orifice.

The amazing new Clark Duo-Step design actually *doubles* the drainage capacity of Clark Steam Traps. This means *double value* anyway you figure it. Now you can use smaller, less expensive traps for larger drainage jobs or get *twice* the drainage from traps you have been using.

Sound good? It is! Better look into Clark Duo-Step *today* and start saving real money on your steam trap requirements.

THE CLARK MANUFACTURING COMPANY
1846 East 38th St., Cleveland 14, Ohio

GET THE WHOLE AMAZING STORY, SEND FOR THIS BOOKLET -Today!

Clark DUO-STEP Leverage

Clark FLUID CONTROLS

PERSONALS

Marion W. Boyer, formerly vice president and director of Esso Standard Oil Co., has accepted the post of general manager with the Atomic Energy Commission. **William Naden,** director and general manager of Esso's Everett, Mass., refinery, has been elected vice president.

Mr. Boyer

Mr. Naden

Mr. Boyer for a short time was a school teacher. After two years at the Georgia School of Technology he became an instructor in science and mathematics at the Daleville, Ind., high school. In 1926 he accepted a teaching position at Massachusetts Institute of Technology where he had taken his master's degree in chemical engineering. The next year, he gave up teaching to join Standard Oil of New Jersey (now Esso Standard) as a research chemist.

Three years later, he was appointed director of the company's laboratories at Baton Rouge, La. He was made head of the technical division of the refinery in 1931, later becoming general superintendent. He was appointed a director of Standard Oil Co. (La.) and assistant manager of manufacturing in 1935, and in 1936 was made a vice president and general manager of the refinery. In 1945 he became a vice president and director of Esso, in charge of Louisiana operations. He assumed responsibility for all Esso Standard manufacturing operations in 1949.

Mr. Naden's career has been spent in manufacturing operations and administrative posts. In recent years, he has also headed the company's employee relations. From 1934 to 1944 he was successively general superintendent of the Everett plant and the Baltimore refinery. During the last war he was director of refining for District I, Petroleum Administration for War. He returned to the company in 1944 and was made manager of employee relations. Two years later, he was named a director. In 1949, Mr. Naden returned to manufacturing as director and general manager of that function.

* * *

L. W. Alberts, manager, and **Jack Bardin,** engineer, of the synthetic fuels and chemicals department in Blaw-Knox Co.'s chemical plants division, are in Europe to study the newest developments in these fields.

Blaw-Knox has contracts with the Ruhrchemie and Lurgi companies of Germany and with other European firms for the use of techniques developed in Fischer-Tropsch synthesis, Oxyl synthesis, and other processes of commercial interest.

* * *

Dr. J. Bennett Hill, Marcus Hook, Pa., manager of the Development Division of Sun Oil Co., was awarded a "Certificate of Appreciation" by the API Board of Directors, to be presented at the API 30th Annual Meeting in Los Angeles, Nov. 13-16. The award was in recognition of his work as chairman of the API Advisory Committee on Fundamental Research on Composition and Properties of Petroleum. The Certificates are awarded to members of the petroleum industry for outstanding work in connection with industry activities.

Dr. Hill

Dr. Hill attended the University of Pennsylvania, receiving his B.S. in chemistry in 1913, Ph. D. in 1916 and a degree in chemical engineering in 1937. He was chief chemist for Atlantic Refining Co. from 1924 to 1934 and was then employed by Sun Oil Co.

* * *

Dr. **Daniel P. Barnard W.** research coordinator for Standard Oil Co. (Ind.), will receive the 1949 Horning Memorial Award at the coming annual meeting of the Society of Automotive Engineers in Detroit. The title of his speech at that time will be "The Role of Fuel in Engine Development."

Dr. Barnard

The Horning Award is given in recognition of distinguished service in the field of mutual adaptation of fuels and engines.

Dr. Barnard attended the University of Delaware and received the de-

Esso Man Honored on 50 Years' Service

Stanley C. Hope, (right) president of Esso Standard Oil Co., and **G. A. Esty,** (left) superintendent of the Bayonne, N. J., refinery, congratulate **Stanley Beigrowicz** for his 50-year career with the company. Mr. Beigrowicz was presented a gold watch and chain and was the guest of the board of directors at luncheon in the New York office. He is a first class machinist at the Bayonne refinery.

grees of master and doctor of science at MIT. After three years in the research laboratory of applied chemistry at MIT he joined Indiana Standard in 1925 as assistant director of the Whiting refinery to establish the company's automotive engineering laboratory. In 1938 he became associate director of research and in 1945 was transferred to the general offices in Chicago, becoming research coordinator in 1948. He is president of the Coordinating Research Council of the SAE and API, and chairman of the automotive research committee of the API.

* * *

H. R. Kemmerer has been appointed assistant manager of Shell Oil Co.'s manufacturing-research department in New York. He was formerly manager of the products application department in the company's Wood River, Ill., refinery. **G. L. Stetson,** senior engineer in the products application department, has succeeded Mr. Kemmerer.

A graduate of Pennsylvania State College, Mr. Kemmerer joined Shell in 1935 as junior mechanical engineer at the Wood River refinery. In 1939 he was made senior research engineer and was made a senior applications engineer two years later. He was appointed head of the products application department in 1942 and in 1944 became chief research chemist. The following year he was transferred to the Houston refinery as research director. He returned to Wood River in 1947 as manager of the products application department and remained in this position until his recent transfer to New York.

Holder of B.S. and M.S. degrees in mechanical engineering from the University of Wisconsin, Mr. Stetson began his Shell career in 1933 as a tester in the motor testing laboratory at Wood River. The following year he was made junior mechanical engineer and was transferred to the main office in St. Louis as engineering research assistant in the aviation department, marketing. When the main office was move to New York in 1940 he became technical assistant in this department. In 1941 he was transferred to the products application department as a senior field engineer. In 1935, after three years military service, he returned to this department as a senior engineer.

* * *

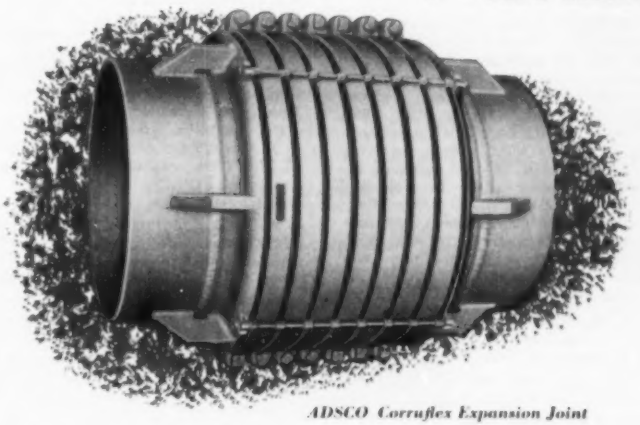
Don V. Eells has been appointed manager of the new terminal and compound plant of Cities Service Oil Co. (Del.) at Chicago. He has been refinery manager at Ponca City since 1942.

* * *

S. R. McMurry, formerly foreman of cracking operations at the East Chicago, Ind., refinery, has been named to succeed Eells at Ponca City.

Eells is a long-time Cities Service

Don't get caught with your plants down!



ADSCO Corruflex Expansion Joint

As America gears for more production

downtime *must* be eliminated, but it isn't going to be easy! Higher production...with greater wear on all equipment...will keep your maintenance crew jumping. In all probability, you'll suffer personnel losses and high turnover. You know you're going to have some tough maintenance problems.

One of them you can lick right now with ADSCO *Corruflex* Expansion Joints. Installed in your pipe lines, they require no maintenance. There's no packing...no lubrication...no adjustment in service. And they're *dependable*...made by the pioneers of the expansion joint industry, manufacturers of the most complete line of expansion joints in the world!

ADSCO *Corruflex* Joints are available in sizes from 3" to 24", single or double units, single or multiple corrugations, with or without self-equalizing rings, and with flanged or welding ends. They are supplied in copper, stainless steel or other alloys and with internal sleeves if required.

***Corruflex* Joints have traverses ranging from fractions of an inch to 15" and operate under pressures from vacuum to 300 psi and temperatures from sub-zero to 1600F.**

SEND FOR NEW 16-PAGE BULLETIN

Simplified selection charts . . . summary of installation practice . . . complete data on all *Corruflex* Joints . . . *Bulletin No. P-35-51.*

Expansion Joints
Steam Traps · Meters
Anchors · Guides

ADSCO
Since 1877

Heat Exchangers
Strainers · Separators
Casing · Supports

AMERICAN DISTRICT STEAM COMPANY, INC. * North Tonawanda, N. Y.

employee, having joined the company in 1917. He was on the refining division staff of Cities Service at Tulsa for five years, transferring to Ponca City in 1925 as assistant superintendent, and to the refinery at Okmulgee, Okla., as superintendent from 1927 to 1938. He was returned to Ponca City in 1938.

McMurry joined the company at Gainesville, Texas, in 1924. After serving as a junior engineer, he worked in various capacities in connection with operation of pressure stills at Gainesville. In May, 1930, he was transferred to the Cities Service refinery at East Chicago, serving as pressure still cleanout foreman, assistant pressure still foreman and pressure still foreman. Upon completion of the $20 million modernization and expansion program at East Chicago last year, McMurry was placed in charge of all cracking and affiliated activities.

H. H. Hewetson has retired as a director and chairman of the board of Imperial Oil, Ltd.

Mr. Hewetson started wtih Imperial at the Sarnia refinery following his discharge from the R. A. F. after World War I. He later served with other companies in the U. S. and South America, returning to Imperial in 1935. He became successively, a director, vice president, president and in 1949 he was made chairman of the board. Mr. Hewetson was also recently elected a director of Jersey Standard.

Allan Whitney has been named administrative assistant to the general superintendent at Esso Standard Oil Co.'s Bayway refinery at Linden, N. J. He relieves **Gordon R. Dalglish,** who is on military leave of absence.

Changes in the API division of refining committee membership since June 1, 1950, follow:

Committee on Analytical Research: **L. L. Davis,** Continental Oil Co., Ponca City, Okla., replaces **C. A. Nielson,** Continental Oil Co.

Committee on Petroleum Products: **J. S. Hume,** Continental Oil Co., Ponca City, has been added to membership.

Committee on Training: **A. H. Houseknecht,** Esso Standard Oil Co., New York, replaces **H. D. Kolb,** Standard Oil Development Co.

Committee on Refinery Equipment: **Turner C. Smith,** General Petroleum Corp., Los Angeles, has been added. **L. W. Vickery,** Continental Oil Co., Ponca City, replaces **M. E. Clawson,** Continental Oil Co.

Subcommittee on Corrosion: **Turner C. Smith** and **J. S. Hume** have been added.

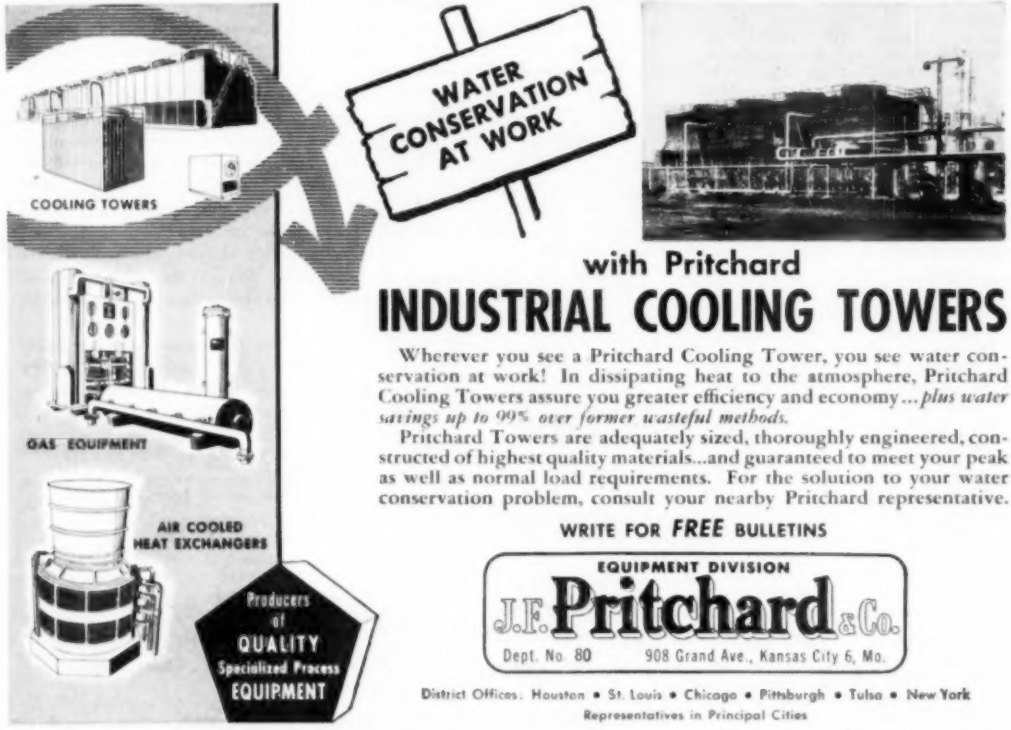
Subcommittee on Pressure-relieving Systems: **Turner C. Smith** has been added. **L. W. Vickery** replaces **M. E. Clawson.**

Subcommittee of Refinery Inspection Supervisors: **Turner C. Smith** and **J. S. Hume** have been added.

Subcommittee on Unfired Pressure Vessels: **Turner C. Smith** has been added. **L. M. Vickery** replaces **M. E. Clawson.**

Joint Subcommittee on Field-assembled All-welded Pressure Vessels: **W. L. Bowler,** chairman, The Pure Oil Co., Chicago. The following represent vessel fabricators: **H. L. Babcock,** Graver Tank and Manufacturing Co.; **H. C. Boardman,** Chicago Bridge and Iron Co.; **James Earthman,** Wyatt Metal and Boiler Works; **H. O. Hill,** Bethlehem Steel Co.; **J. O. Jackson,** Pittsburgh Des Moines Co.; **F. L. Plummer,** Hammond Iron Works; **J. C. Thompson,** General American Transportation Co.

The following represent petroleum companies: **P. D. Barton,** Sun Oil Co.; **G. C. Dick,** Shell Oil Co.; **A. J. Ely,** Standard Oil Development Co.; **M. E. Holmberg,** Phillips Petroleum Co.; **N. J. Rees,** Socony-Vacuum Oil Co., Inc.; **G. W. Watts,** Standard Oil Co. (Ind.).



with Pritchard

INDUSTRIAL COOLING TOWERS

Wherever you see a Pritchard Cooling Tower, you see water conservation at work! In dissipating heat to the atmosphere, Pritchard Cooling Towers assure you greater efficiency and economy ... *plus water savings up to 99% over former wasteful methods.*

Pritchard Towers are adequately sized, thoroughly engineered, constructed of highest quality materials...and guaranteed to meet your peak as well as normal load requirements. For the solution to your water conservation problem, consult your nearby Pritchard representative.

WRITE FOR *FREE* BULLETINS

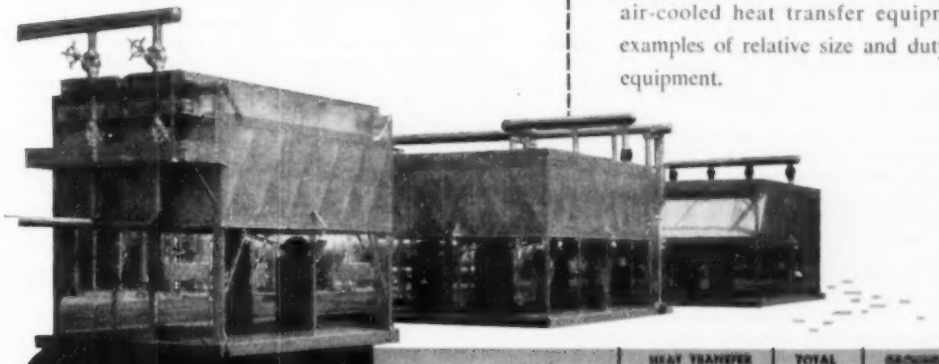
EQUIPMENT DIVISION
J.F. Pritchard & Co.
Dept. No. 80 908 Grand Ave., Kansas City 6, Mo.

District Offices: Houston • St. Louis • Chicago • Pittsburgh • Tulsa • New York
Representatives in Principal Cities

Here are 15 TYPICAL APPLICATIONS for

FIN-FAN
AIR-COOLED
Heat Exchanger Equipment

For many years, Fin-Fan Air-Cooled Heat Exchangers have proved their worth by giving reliable, economical service in many and varied applications. The Fluor Corporation, Ltd., and Griscom-Russell Company, pioneer-partners in the air-cooled heat transfer field, offer the following to show the large variety of practical applications for air-cooled heat transfer equipment and examples of relative size and duty of such equipment.



	SERVICE	HEAT TRANSFER (BTU/HR.)	TOTAL H.P.	GROUND SPACE
GAS COOLING	Natural Gas After-Cooler	13,920,000	80	46' x 25'
	Manufactured Gas Cooler	11,165,000	50	23' x 21'
	Natural Gas After-Cooler	3,400,000	15	11' x 21'
	Natural Gas Inter-Cooler	7,890,000	40	23' x 21'
VAPOR CONDENSING	Reflux Condenser	18,407,000	90	48' x 25'
	Primary Condenser	4,652,000	40	11' x 25'
	Still O.H. Condenser	4,875,000	34	16' x 21'
	Debutanizer Condenser	11,930,000	60	23' x 25'
	Still Reflux Condenser	39,110,000	60	46' x 25'
	Steam Condenser	87,300,000	300	138' x 31'
	Steam Condenser	2,880,000	10	10' x 6'
LIQUID COOLING	Vegetable Oil Cooler	628,000	15	6' x 17'
	Absorption Oil Cooler	14,915,000	100	32' x 17'
	Quenching Oil Cooler	1,665,000	50	23' x 25'
	Amine Solution Cooler	19,300,000	175	38' x 25'
	Stabilized Crude Cooler	125,100,000	700	315' x 25'
	Jacket Water	2,400,000	5.5	16' x 12'
	Jacket Water	28,800,000	100	70' x 24'

A new 8-page bulletin on Fluor-GR Fin-Fan Heat Exchangers is now being prepared. Write in and reserve your copy by post card or letter.

Why Fluor-GR Fin-Fans Lead The Field

The Fin-Fan Air-Cooled Heat Exchanger is unique in its development and manufacture. It is the result of the engineering skill of *two* companies, *each* long recognized as leaders in their respective fields. It combines Fluor's experience in the design, fabrication and field erection of air-moving systems with Griscom-Russell's experience in heat transfer.

Success is evident in repeat orders. Since 1941, hundreds of Fluor-GR Air-Cooled Heat Exchangers have been installed throughout the world . . . nearly 50% have been repeat orders!

FLUOR

BE SURE WITH FLUOR

ENGINEERS • CONSTRUCTORS • MANUFACTURERS

THE FLUOR CORPORATION, LTD., 2500 S. Atlantic Blvd., Los Angeles 22, Calif., *Offices in principal cities in the United States*
REPRESENTED IN THE STERLING AREAS BY: Head Wrightson Processes Ltd., Teesdale House, Baltic Street, London, E.C.1., England

EDITORIAL VIEWPOINTS

Opinions and Comments on Current Topics

Future of Natural Gas Liquids

A SIGNIFICANT trend in the utilization of natural gas liquids is the direct use of LPG as motor fuel in commercial vehicles and as fuel in farm tractors. This is not a new use but it is expanding, due to certain economic advantages of LPG as compared with motor gasoline and also due to the increasing availability of LPG in many parts of the country.

Authorities in the natural gasoline industry see a potential utilization of LPG as motor fuel amounting to from 10 to 20% of our total motor fuel production. It is recognized that to develop anywhere near this volume of use will require the interest and cooperation not only of the oil companies, but of equipment manufacturers, transportation authorities, legislative and regulatory bodies, and consumers themselves. Given a normal period of development this utilization could make a sizeable addition to civilian supplies of motor fuel in the event of war and gasoline rationing. The rate at which natural gas reserves are being increased, together with the increased net recovery of liquids from gas, leaves no doubt in the minds of the authorities that potential supplies of LPG are available for a market that conceivably could be two or three times the volume of the present output of LPG for all purposes.

The extent to which the market for LPG for motor fuel will be developed depends on many factors, among them the price level and price stability, it can be said in passing. It is evident, however, that the large expansion of recent years in the utilization of natural gas liquids has been chiefly through its direct use in one form or another. Demand for LPG for 8 months of this year has been about 25% larger than in the same period in 1949. The demand for natural gasoline, used principally in indirect form as a component in motor gasoline, is around 8% larger than a year ago. This same ratio in growth of demand held in 1948 and 1949.

Discussions such as that by R. C. Alden of Phillips Petroleum Co., reported in this issue (pg. 1180), serve to point out to the petroleum industry the magnitude of the future supplies of liquid fuels which will be available through our expanding natural gas reserves.

Bigness No Prerequisite to Research

ASK any man how he visualizes oil company research today and your answer will most likely be in terms of glamour—unique products from petroleum or unusual processes for making those products.

But oil company research need not be based on "bigness," on Hollywood-like notions of scientists, on vast laboratories, and huge financial expenditures. Some oil companies are doing quite well with perhaps more limited budgets by emphasizing their research and development programs on highly important and specialized problems. Among the possibilities for valuable research are problems in automatic process control and instrumentation.

For example, two recent articles in this magazine point up the interesting work being done in instrumentation by Sun Oil Co. The first (Sept., 1950, pp. 941-45) described the results of a cooperative development by Sun and Instruments, Inc., on the design of a recorder using radio active energy for the difficult task of catalyst level measurement in a cracking unit. The second (this issue, pp. 1188) relates how Sun engineers adapted the familiar dial telephone idea to the complex job of rapid, multiple temperature recording in a refinery.

Sun happens to be out of the so-called "giant majors" class. Other concerns undoubtedly are also engaged in similar active research programs. The important point is that the big majors do not have a corner on the research market. True, their programs, especially with regard to processes and products, have gained wide recognition, and deservedly so. However, Sun Oil's activity in research on instrumentation is an excellent example of the valuable and less publicized work done in the petroleum industry.

The Home Guard: 1951-52 Model

IN THE wars of years ago the protection of the homes of its citizens was the chief concern of a nation next to building up its strength on the fighting front. The training of men not in the armed forces was to the end of defending home and families in the event of an enemy breakthrough or invasion. However, in the highly mechanized warfare of modern times, the industries of a nation that supply the fighting soldiers become more important objects of enemy destruction than homes, even more important primarily than the armies themselves.

Lacking visual evidence of any danger, the oil companies along with many other industries are lagging in tightening their plant protection and security programs. Such programs hurriedly organized against an actual time of dire need, will not prove of great protection against the various forms in which an attack may come. The tightening of the refinery gate now, the setting up of protective measures against sabotage and espionage, will familiarize the plant force with steps necessary for security, with a better chance of the defense being effective if later actual needs required.

Again, taking the required measures at this time would serve to keep before operators, supervisors and others every day the fact that as a nation we are arming and girding to protect ourselves by every means possible. It would be daily evidence that the plant management is concerned about the protection of their men and their work and is taking steps for their security. Such action might serve to shake off the complacency of any danger that exists in so many quarters, and to make all who came in contact with the program more receptive to the fact that burdens must be assumed and sacrifices made if we are to toughen ourselves into a nation prepared for ruthless armed conflict if it is forced upon us.

3 IMPORTANT WAYS

B&A "Custom-Made" Chemicals Help Leading Manufacturers Solve Production Problems

CASE #1—*Laboratory chemicals produced in commercial quantities for Pharmaceutical manufacturer!*

A pharmaceutical manufacturer needed a special chemical in compounding a new antiseptic preparation. Study proved B&A's purified Calcium Acetate, hitherto marketed only in laboratory size packages, fulfilled the requirements. B&A "know-how" and B&A productive facilities combined to give this manufacturer commercial quantities on time to meet pressing manufacturing schedules.

CASE #2—*Special form of basic chemical developed for Paint Industry!*

A leading paint producer turned to B&A for Ammonium Oxalate of special quality and screen size urgently needed for a new type of paint formulation. Again, B&A met the problem, producing this new chemical form to exacting specifications, in the tonnages required.

CASE #3—*Exclusive formulation prepared from Textile manufacturer's secret specifications!*

Formula "X" was prepared in commercial quantities on short notice for a leading textile manufacturer . . . one of many customers who regularly entrust their private formulas to B&A. Naturally, both specifications and end uses are always held in strictest confidence.

WHAT IS YOUR PROBLEM?

Whether you need commercial quantities of a laboratory chemical, or an entirely new chemical "custom-made" for your specific use, it will be to your advantage to contact your nearest B&A office immediately. B&A has the men, methods, and materials to handle custom-made chemical assignments swiftly and surely.

BAKER & ADAMSON *Fine Chemicals*

GENERAL CHEMICAL DIVISION

ALLIED CHEMICAL & DYE CORPORATION

40 RECTOR STREET, NEW YORK 6, N. Y.

Offices: Albany • Atlanta • Baltimore* • Birmingham* • Boston • Bridgeport* • Buffalo* Charlotte* • Chicago* • Cleveland* • Denver* • Detroit* • Houston* • Jacksonville Los Angeles* • Minneapolis • New York* • Philadelphia* • Pittsburgh* • Providence* St. Louis* • San Francisco* • Seattle • Yakima (Wash.)
In Wisconsin: General Chemical Company, Inc., Milwaukee, Wis.
In Canada: The Nichols Chemical Company, Limited • Montreal* • Toronto* • Vancouver*

SETTING THE PACE IN CHEMICAL PURITY SINCE 1882

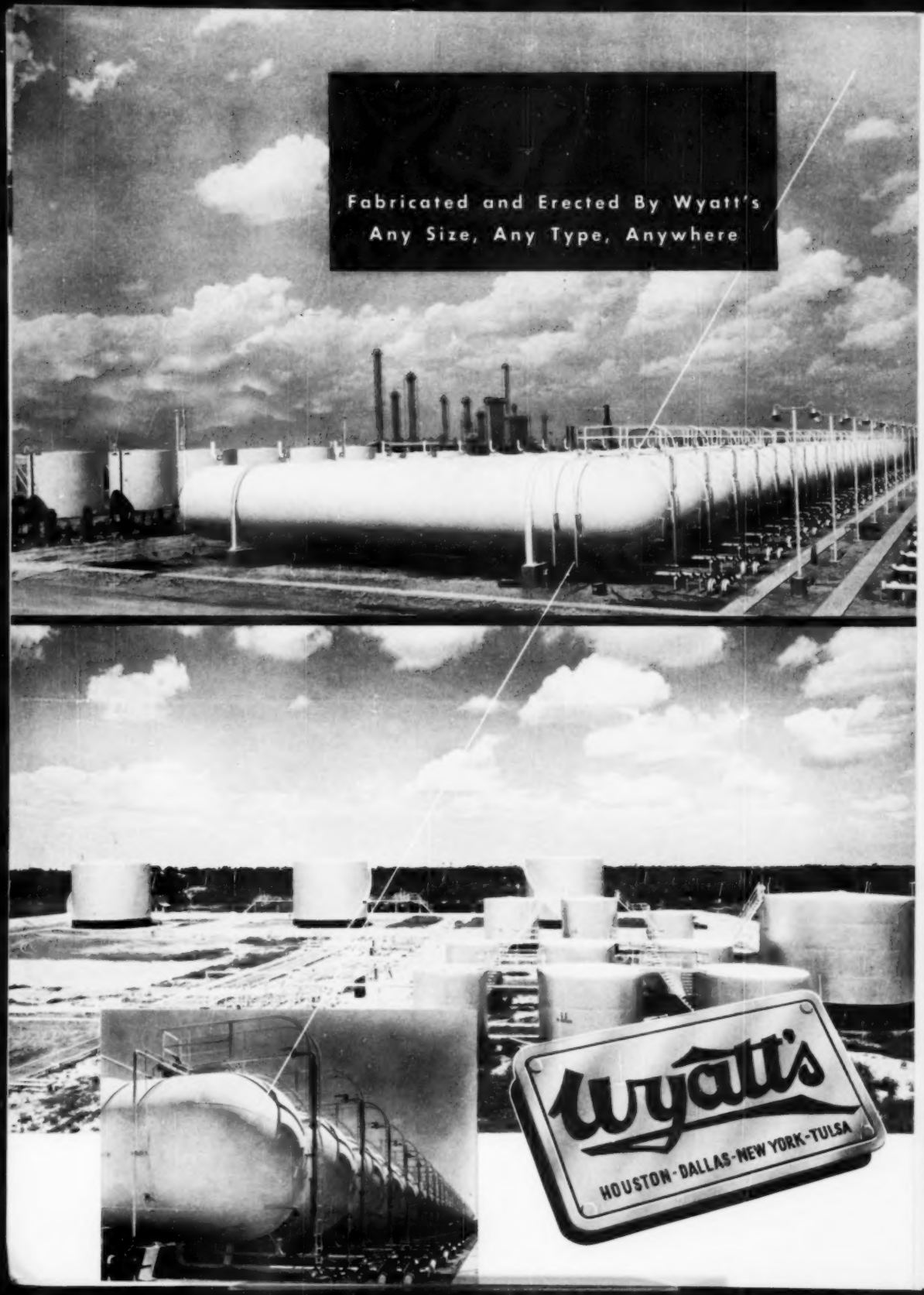
* Complete stocks are carried here.

REAGENTS

B&A

STANDARD OF PURITY

FINE CHEMICALS


Fabricated and Erected By Wyatt's
Any Size, Any Type, Anywhere
Wyatt's
HOUSTON-DALLAS-NEW YORK-TULSA